THE

ELECTRICAL REVIEW.

VOL. LII. FEBRUARY 20, 1903. No. 1,317.

"ELECTRICAL REVIEW."

Vol. LII.] CONTENTS: February 20, 1903. [No. 1,317.

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THE

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COMBINATION IN THE GERMAN ELECTRICAL ENGINEERING INDUSTRY.

THE second stage in connection with the ultimate amalgamation of the principal concerns in the German electrical engineering industry has been reached in such an astonishingly brief space of time as to lead to the conclusion, whether rightly or wrongly, that a gigantic organisation formed of two or three groups working together in harmony will be brought into existence at an early date to control the greater portion of the home and foreign trade of the Fatherland. It is scarcely two months since we recorded the establishment of a community of interests between the Allgemeine Elektricitäts Gesellschaft and the Union Electricity Co., and in referring in our issue of January 2nd, 1903, to the fact that several years had been required in order to bring about the first step in the direction of consolidating the trade, we ventured to say that a similar period might not be needed to complete the remaining stages in this respect. It would now appear that this prediction is in a fair way of being fulfilled, seeing that the shareholders of two other important companies will next month be asked to approve provisional agreements which have been entered into by the directors and boards of supervision of the undertakings respectively. These are the Siemens & Halske Co. and the Schuckert Electrical Co., although the latter was unable to arrive at an understanding for an amalgamation with the A.E.G. some months ago. In the course of an official communication, the boards of supervision announce having approved an agreement which has for its object the foundation of a common enterprise which will henceforth absorb and carry on the manufacturing and sales departments of both companies, in so far as the heavy electrical engineering branches are concerned. The Schuckert Co. will therefore transfer to the amalgamated undertaking its works at Nuremberg, whilst the Siemens & Halske Co. will bring in the dynamo works at Charlottenburg and the cable factory at the West-end, Berlin. The new enterprise is to be in the form of a private company with a capital of £4,500,000, and the working capital on both sides will be furnished by the stocks of material, manufactures and outstandings of about equal value in each case, but it will exclude the securities, shares, enterprises, and existing guarantee liabilities of both companies. The official communication concludes by stating that the new company will bear the title of the Siemens-Schuckert Works Co., and the agreement, subject to the approval of the shareholders, will come into operation at the beginning of April.

The incentive to the new combination is to be found in the community of interests established between the A.E.G. and the Union Co. last December, and the fact that the Siemens & Halske Co. is one of the interested parties is all the more surprising at the present moment, when it is remembered that in the company's report which was issued

as recently as two months ago, the directors expressed the opinion that independent action is necessary if the German electrical industry is to be maintained in the van of technical progress. Leaving, however, this question on one side, the fact should be mentioned that the present Siemens & Halske Co. is the result of the absorption of the undertaking of the firm of that name, which took place in 1897. The share capital, which originally amounted to £1,750,000, has been increased by successive stages to £2,725,000, whilst bonds have been issued to the extent of £1,500,000. Since its formation the company has paid four dividends of 10 per cent., and 8 per cent. and 4 per cent. in the past two years respectively. As far as the Schuckert Co. is concerned, the undertaking was formed in 1893 with a capital of £600,000, which has gradually been advanced to £2,100,000, and it has an issue of bonds amounting to £1,750,000. During the first two years of its existence the company distributed dividends of 9 per cent. and 10 per cent. respectively; in each of the following three years it paid 14 per cent., and 15 per cent. in each of the subsequent two years. The dividend of 10 per cent. proposed for 1900-1901 was, however, not divided owing to the collapse of the Leipsig Bank, which rendered it necessary for the Nuremberg company to pay immediately £210,000 for shares in the Bosnian Electricity Co., whilst the past financial year terminated with a loss of over three-quarters of a million sterling.

The first point which strikes the careful observer is the vast difference between the new combination and its predecessor. On the one hand, we have an agreement between the A.E.G. and the Union Co. for a period of 35 years, which provides for a pooling of the profits in the proportion of $\frac{1}{2}\frac{5}{6}$ths to the former and $\frac{1}{1}\frac{1}{6}$ths to the latter, the arrangement comprising the whole of the transactions of the two companies. On the other hand, the agreement between the Siemens & Halske Co. and the Schuckert Co. only includes the manufacturing and sales departments in the heavy electrical engineering branches; it entirely excludes the shares or securities held by both companies in other companies, it leaves out of consideration the investments in trusts, it does not touch any tramways or central stations worked by the companies themselves, and it has nothing to do with any guarantees which the original concerns have assumed in the past. In the case of the Schuckert Co., this means that the new combination will be entirely free from the former's interest in its trust (the Continental Co. for Electrical Enterprises), which figured for over £720,000 in the last balance-sheet, and from the central stations, &c., in own working, which were represented by £355,000. On its part the share of the Siemens & Halske Co. in the amalgamated enterprise, will exclude, in addition to its interests in the Russian Siemens & Halske Co. and in others, the guarantee advances which now amount to £60,000 per annum. Naturally enough, many details in connection with the two companies have yet to be settled. The Siemens and Halske Co.'s telephone factory in Berlin will be continued on its own account, but what is to become of the four branches of the Schuckert Co. in Leipsig, Cologne, Munich and Berlin respectively? Then again, an arrangement will have to be made with the Felten & Guilleaume Co. which has hitherto supplied the cables required by the Nuremberg Co., but in future the Berlin factory of the other partner in the agreement will most probably meet all the requirements in this direction. These and other matters will form the subject of further negotiation, and need not be again referred to in this place.

It remains to be seen what the shareholders and the bondholders in each company will have to say in regard to the provisional agreement, details of which are lacking at the present time. In the first place, the new combination is proposed to be constituted as a private company partly for the purpose of effecting economies, including exemption from the payment of income-tax, but mainly because, as it is contended, of the simplicity of administration in this form. As a private company, however, the amalgamation will possess the disadvantage, from the point of view of shareholders and bondholders, that they will apparently lose control of the greater portion of their property, as the company will not be compelled to publish balance-sheets, or detail the profits earned, or the amounts written off for depreciation every year. The existing shareholders and bondholders would have to look to the original companies, as carried on in their attenuated form, for their dividends and interest payments respectively. It will be obvious that this particular point is of considerable importance, especially as the combination, with its enormous capital, will be the largest private company in Germany; but there is little doubt that the directors of both companies will be able to give satisfactory explanations which will convince both classes of proprietors of the wisdom of sanctioning the projected amalgamation. The Schuckert Co., in particular, stands to gain by the combination, seeing that it obtains the support of the powerful banking syndicate of its intended partner, in addition to retaining the banks at its back at the present time. The question of the precedence of the financial supporters, which is said to have hindered the fusion of the A.E.G. and the Nuremberg Co., has apparently not arisen in the present case, or if it has it has been overcome, as both groups of banks will work together in harmony in the future.

The formation of a second German combination cannot fail to be of special interest to British firms, who will recognise in the movement now proceeding in the Fatherland an attempt not only to improve the position of affairs in that country, but also the forging of a more powerful weapon for meeting English competition in all parts of the world. The A.E.G., as the originator of the idea of amalgamating the German electrical industry, is said to be pleased at the turn of events, and the Stock Exchanges have cordially welcomed the combination by advancing the prices of the two companies concerned, and also of certain other electrical companies. But the new amalgamation does not complete the list. There still remain the Lahmeyer Co. and the Helios Co., and these may, from the force of circumstances, either be compelled to amalgamate at an early date, or become associated with one or the other of the two combinations in question. As one of these courses will probably be taken, we shall then have the heavy electrical engineering trade of Germany controlled by two or three groups, and it is easy to predict the final result in the form either of a trust or a working arrangement on a syndicate basis in the matter of prices and markets. It is well known how prejudicial to British firms the operation of the German iron and steel syndicates has been, and in the events which may be forthcoming in the Fatherland before long, the possibility exists of a repetition of those disastrous effects in relation to the electrical trade of this country. It is, indeed, a contingency which may have to be reckoned with—unless the combinations overreach themselves.

Finchley and Overhead Wires.

In the autumn of 1901, the Finchley Urban District Council adopted the high-handed course of cutting the overhead wires erected by the local Electric Light Company. The company contested the right of the Council to interfere with them, but at the trial of the action Mr. Justice Farwell

gave judgment against them, on the ground that the Council owned the fee simple of the road across which the wires were run and were justified in what they had done. This decision has now been reversed by the Court of Appeal, before the Master of the Rolls and Lords Justices Romer and Cozens-Hardy, who were of opinion that the local authority became the owners of only so much of the space above and below a street as was necessary for the ordinary use of the street as a street, and granted an injunction restraining the Urban District Council from cutting or interfering with the company's wires. This result leaves the question of overhead wires in the position pointed out by us in our leading articles of September 20th and October 11th, 1901, viz., that suppliers of electricity without statutory powers are in a better position as to the employment of overhead wires than undertakers working under provisional orders. In the one case all that is necessary is to comply with the Board of Trade regulations for the safety of the public, and of the electric lines and works of the Postmaster-General or others, used for telegraphic purposes, while in the other case the consent of the local authorities must be obtained in accordance with the 14th Section of the Electric Lighting Act of 1882. This anomaly ought to be redressed at once, as there can be no valid reason for subjecting statutory undertakers to disadvantages, under which companies do not suffer who are supplying towns without provisional orders. The decision in the Finchley case confirms that of the Wandsworth contest with the National Telephone Co., of which the Finchley Council ought to have been aware, and which should have prevented their reckless proceedings and the heavy cost to the ratepayers of trying to crush a small private company of whose proceedings they appeared to be jealous. This subject is commented upon by our legal contributor in another column.

A Story from Fulham.—And it came to pass, after a few years, that trouble again broke out in the land of the Fulhamites. It was in the fourth year of the reign of King Medhurst, that the Chief resigned his office, and a new one had to be appointed in his stead. On a certain day the councillors of Fulham, noted for their wisdom and much learning, assembled in state to consider the matter and decide whom to beseech to favour them with his services, and the lot fell upon one, Chief Fuller, from the land of Ayr. And it was known for many miles round that in future, next to the King, the land was to be controlled by Chief Fuller, of Fulham. But Fuller, who so ably governed the state of Ayr, felt fearful of certain fractious elements in the land of Fulham, and with a loud voice exclaimed that he would not be responsible for the peace of the people if that horizontal element remained. At this the King was extremely wrothful, and in his great anger he arose and denounced Chief Fuller, stamping his feet and tearing his ayr. And very hard words passed between them. The King denied that the afore-named elements were in any degree fractious, and he solemnly declared that the land "would suffer tremendously," and his own "reputation would be seriously and injuriously affected" if they were done away with. He appealed to his councillors, with their great wisdom and much learning, to decide whether it were right for this new chief to be engaged to govern the land, or whether a new land should be found where he would be free from the aforesaid troubles. And he ended by beseeching his councilors to leave the matter in his control for a time, and he would see that the trouble, which he declared to be due to the shortcomings of a former chief, were remedied. Then they could invite some new chief to control their affairs. Or, as an afterthought, why not engage the High Precast of Queen Anne's Gate to prepare a full report upon the whole matter. He would be prepared to dig into his commission bags and pay half the fee if his most noble councillors would meet him half way. And a section of the councillors favoured the idea. But after Chief Fuller had spoken another word in the ear of the councillors, it was resolved that one learned in all that appertains to entropy and many of the other scientific problems of his day, should be asked to report, or nominate a capable expert. And the Council, in the presence of the King, decided that this was the course most likely to put an end to the squabble, and to such new expert they would pay out of the municipal purse, provided by the people, one hundred and fifty golden guineas. The local records do declare that while the councillors were sitting to weigh this very serious question, the King made his voice heard "in approval of remarks favourable to himself and the system for which he was said to be responsible."

THE INFLUENCE OF ELECTRICAL DRIVING ON MACHINE SHOP PRACTICE.

A great deal has been written, from time to time, on the subject of the application of electric motors to machine-tool driving, generally with the object of showing the saving in cost which may be effected by this means.

The losses in shafting and belting have been carefully measured in various typical engineering works, and from the tabulated data published there is no doubt that losses ranging from 50 per cent. to 80 per cent. of the total power generated are not uncommon in works devoted to engineering products and managed by engineers. In works not so fortunately placed, it may be not unreasonable to suppose that losses equal to, or greater than, these occur.

The latest serious contribution to the literature of the subject is a paper entitled "The Requirements of Machine Tool Operation with Special Reference to the Motor Drive," read before the New York Electrical Society on December 17th last, by Mr. Charles Day, of the firm of Dodge & Day.

That the subject of machine-tool driving is at the present time receiving special attention in America, is evidenced by the number of papers recently read before the American Institution of Electrical Engineers on "Methods of Motor Speed Control."

Mr. Day's paper deals with the matter from the machine tool point of view, rather than from that of the motor, and he shows both clearly and forcefully the preponderating importance of tool steel in the modern shop, and contrasts present day conditions with those in vogue in pre-machine-tool times.

"Long ago," he says, "when the blacksmith laboured over his anvil drawing out, lapping and re-drawing many times a bar of steel that was to result in a sword blade of remarkable strength and flexibility, his entire efforts were bent upon arriving at a job of perfection, no matter how long it took to reach the result. Time was a secondary consideration."

To-day *time* is the all-important consideration.

Mr. Day reminds us that, in the early days of machine shops, tool steel was of the crudest character, and Mushet's discovery of air-hardening steel was not generally adopted or appreciated until years after it was made known.

Even to-day, he says, in many machine shops no one can be found who understands anything of the cutting speeds of different brands of tool steel, and machine tools are ordered through a purchasing department, by men who do not understand the first thing about the requirements.

"The tool steel is the keynote to the situation," says Mr. Day, and goes on to point out that carbon steel will give a finer finish on steel than the air-hardening variety. For heavy roughing cuts, air-hardening steel, and the recent developments in the process of hardening, have been the

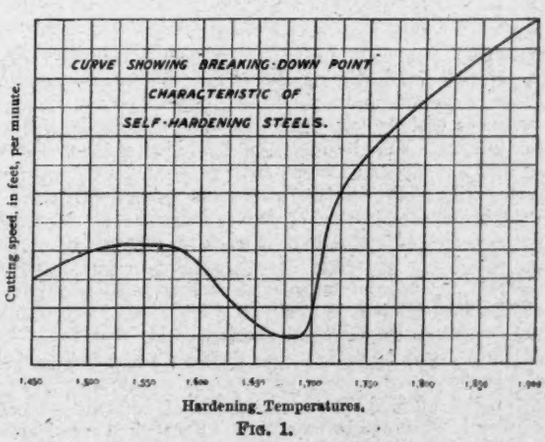


Fig. 1.

direct means of revolutionising old methods of machine tool design and so-called shop practice. To say of any new process or departure proposed in machine tools or methods, "it is not good practice," is generally considered quite a sufficient reason for its non-adoption; in fact, the parrot-cry,

or shibboleth, "good practice," too often stands in the way of progress.

The principle underlying the Taylor-White process, in which the hardening temperature is very much in excess of what was usual some little time ago, is shown in the curve, fig. 1.

It is seen that after temperatures of 1,550° are reached, the cutting speeds fall off rapidly, and this, until the recent tests at the Bethlehem Steel Works, was looked upon as the critical temperature. The curve shows, however, the important and interesting fact that, on carrying the temperature beyond the "breaking-down point," the cutting speed values rise to about three times the former value. Either by oversight or design, the actual figures of cutting speeds are omitted from the curve.

The comparison between steel treated in this way and Sheffield Mushet is given in the table below the curve.

On the subject of motor drive there is little, if anything, that is new in the paper, this matter being more fully dealt with in the papers on "Motor Speed Control" already referred to.

In the early portion of the paper a diagram of costs and selling price is given which suggests one or two points not touched upon by the author.

This diagram is reproduced in fig. 2. It will be noticed that the total cost of a product is divided up into two sections, viz., prime cost and selling expense, these sections being further divided and sub-divided. It is only by plotting out such diagrams as this that one can see where, and to what extent, the costs can be reduced.

When one consults a specialist in connection with any of the ills that human nature is heir to, the specialist, as a rule, has eyes only for the particular ill in which he specialises, and may ignore, because he overlooks, a more serious malady from which the patient may be suffering. Similarly, in considering engineering questions, one is apt, as Mr. Day

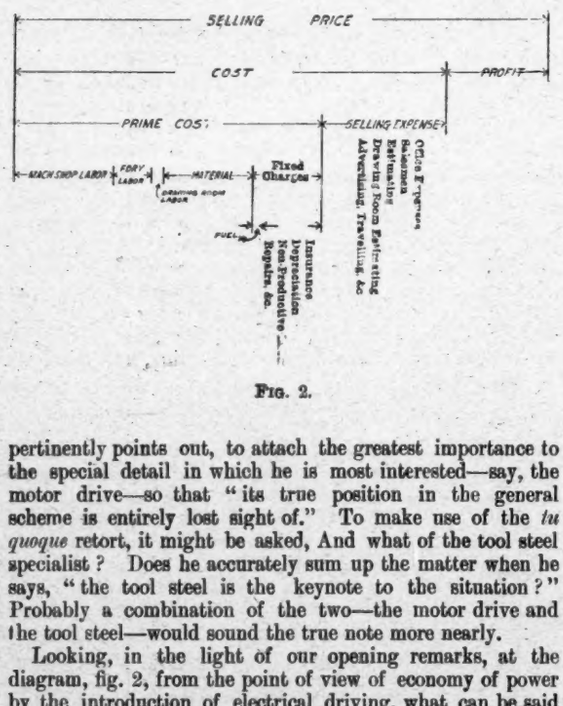


Fig. 2.

pertinently points out, to attach the greatest importance to the special detail in which he is most interested—say, the motor drive—so that "its true position in the general scheme is entirely lost sight of." To make use of the *tu quoque* retort, it might be asked, And what of the tool steel specialist? Does he accurately sum up the matter when he says, "the tool steel is the keynote to the situation?" Probably a combination of the two—the motor drive and the tool steel—would sound the true note more nearly.

Looking, in the light of our opening remarks, at the diagram, fig. 2, from the point of view of economy of power by the introduction of electrical driving, what can be said from the electrical engineer's point of view?

Granted that 50 per cent. of the total power is wasted in the shafting and belting, an economy of, say, 30 per cent. might be effected by the adoption of individual motor driving. This sounds promising. But a close examination of the chart shows that the percentage cost of fuel is so small that, even if the whole cost of it were saved, if this were the only advantage of motor driving, it would not pay the owner to consider it for a moment. The cost of interest and depreciation on the motor equipment would more than wipe out all the saving effected in fuel consumption, and he would be worse off than before.

But is this all? If it were, the prospects of machine-tool driving by motors would be far from rosy.

The fact is, however, that for work of this kind the saving in fuel is insignificant as compared with the increased turnover, or output, due to the more perfect speed control possible with electric motors as against the old-fashioned belted step-cone method.

It is useless to introduce new varieties of tool steel which make high-cutting speeds possible if these speeds cannot be used owing to the restrictions imposed by the method of driving the tool.

To take an example, using data given in Mr. Day's paper. A Lodge & Shipley belt-driven reducing lathe is shown taking a cut 3 in. deep with $\frac{1}{16}$ in. feed at 50 ft. per minute. The material is 50 C. steel.

Now, if the small cone gives a cutting speed of 55 ft. per minute and the intermediate one 45, the latter would probably be used, causing a loss of 11 per cent. in the time taken to complete the turning. On the other hand, with a motor-driven lathe with shunt field control, the exact speed could be obtained and the work expedited.

In turning a flat surface, the lathe-speed must be set to suit the fastest speed of the work, which is, of course, the outer edge; so that as the tool approaches the centre, the cutting speed is decreasing all the time.

With a motor drive, properly arranged, the machine speed can be varied to suit the varying speed of the cutting surface, and so the time required can be very considerably reduced.

In practice it is found that an all-round increase in output of 30 per cent. can be obtained from a given machine shop by a carefully-designed system of motor driving. In some cases this figure might, no doubt, be increased. This increased output far outweighs any question of fuel economy, as it means increased profits, many of the standing charge costs being quite unaffected.

The influence of electrical driving, then, on machine shop practice is greater than might at first sight appear. It permits of the use of high-speed cutting tool steel, it enables this and the machines to be worked at their limits, it reduces shafting and gearing, and obviates any necessity for the stereotyped arrangement of tools parallel to driving shafts, thus permitting a more economical use of space and a better distribution of the machinery, and it gives the men a better control over their work.

But it is necessary in planning any system of motor driving to carefully study the requirements of each machine, and on this point we are in agreement with Mr. Day. It is scarcely necessary to point out that these remarks do not apply to other classes of work, in many of which the cost of power forms a very much higher percentage of the total costs.

SOME STATION NOTES.

The Newcastle Local Section of the Inst. E.E. has recently been entertained by a contribution from Mr. Turnbull. His paper consists of a record of notes made whilst asleep. The author does not say what period of time the notes cover, but as some of the things he has dreamt about, and now springs suddenly upon the world, have been common knowledge for years, it is obvious that Mr. Turnbull's sleep has been something more than a siesta.

That he should have invented during his somnolence a card system of keeping records is a proof, if proof be needed, that transference of thought takes place between the waking and the sleeping.

The controversies on a decimal coinage system seem to have filtered through to dreamland and produced an extraordinary effect on the mind of the sleeper, who, on waking, proceeds to show at some length that 6s. 8d. is 0·332 of a pound; and, having arrived at this remarkable solution, takes up the ordinary 10-in. slide rule and demonstrates the facility with which it may be used in combination with the mnemonic system of calculation described, to work out problems in English coinage. We think that some of the junior assistants in the estimating departments of electrical firms on Tyneside could show him how to arrive at the

decimal equivalent of 6s. 8d. with one motion of the slide, but the result would not be ·332 !

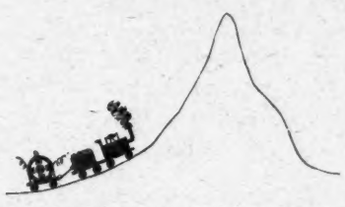
As to the card system, Mr. Turnbull need only go to one of the well-known manufacturers of filing systems, such as have been in use for many years, to see the whole thing cut and dried—yes, and printed ! Among the many standard forms, and he is a stickler for standardisation, he would be able to find more than sufficient to meet his wants.

But card systems, and mental arithmetic, are but the *hors d'œuvres*, the foretaste, so to speak, of better things to follow.

One of the problems that have exercised the minds of engineers for years past, is how to deal with the peak of the station-load curve. Another, which is still taxing the brains of inventors, is the evolution of the gas turbine.

It is one of the most extraordinary things in engineering that the solutions of what are seemingly insoluble problems are often lying before us, staring us in the face, almost *asking* to be taken up. They seem so perfectly obvious afterwards, that it is a matter for wonder how they could have been overlooked so long.

"The peak !" What worry and anxiety it has caused the station engineer ; what numerous and complex systems of charging it has given rise to, including the famous



The Sky-Rocket Peak Load Plant.

maximum demand system, the system which we overheard in a railway carriage the other day, described as one in which "you spend ten pounds to save one;" and what volumes have been written on it! "The peak"—why, it's almost a nightmare—or, let us say, "has been."

For Mr. Turnbull has solved the problem. In his dream (was it a nightmare after all?) his dynamos, on coming to the peak, refused to tackle it; they were overloaded already, and could not do another ampere; in short, they "jibbed." Something had to go; the peak would not shift; so, shutting his eyes, he awaited the inevitable crash. "Puff, puff"—what was that?—A despised, superseded locomotive from the Newcastle-Tynemouth branch line, panting towards the open sea, there to drown its griefs and end its days. It was but the work of a moment to head the locomotive towards the peak, and then to hitch the dynamo to it.* Pulling itself together with one supreme effort, it steadily dragged the dynamo over the peak.

"The scene was changed." It was a gas-driven generating station.

The chief sat at his desk, deep in thought. Before him lay a numerously signed complaint as to the noise from the exhaust, and a threat of legal proceedings.

Suddenly an inspiration comes to him. Why not replace the silencers (so-called) by turbines, and so convert wasteful noise into silent power ?

Aussitôt dit, aussitôt fait. The turbines are put in, and the nuisance ceases. But that is not all. The turbines, generating power by the pressure of the waste gases, are geared to the gas engines,† and as the turbine power increases proportionately with that of the engines, the "peak" becomes mere child's-play to them.

Most men would have patented epoch-making ideas of this kind, and sold the patents to a syndicate. Not so Mr. Turnbull. Like Hughes, who gave the microphone to the world, so Mr. Turnbull presents these momentous solutions in a modest paper read before the Newcastle Section.

Newcastle must be proud, indeed, to have been the scene of so great an act of magnanimity.

* "*Peak Load Plant.*—In many stations the load may be divided into two parts—long-hour load and peak load. In certain cases increase of output does nothing to lengthen the hours of load. It may even make the load factor worse. Hence it seems that stations should put down two kinds of plant—long-hour plant and peak-load plant. I believe that if a locomotive could be hitched on to a dynamo, we would get a combination which would give out some 500 kw. at an abnormally low capital cost, and without any extraordinarily large consumption of coal, and without heavy stand-by losses."

† "It is to be noted also that turbines might be run off the exhaust of gas engines, as they would probably prove better silencers than the present exhaust box. Furthermore, the turbines might either be geared to their engines, or else they might run separate dynamos."

"WHO INVENTED THE MICROPHONE?"

"Decision in the Berliner Case" has, for some years past, been a recurrent heading in the columns of our trans-Atlantic contemporaries. On the 16th ult. the United States Circuit Court of Appeals for the First Circuit delivered their decision in the latest (and probably the last) issue in which the patent has been tried. The judgment is an able exposition of scientific facts, of much interest to English scientists, and places American judges on patent cases in a very favourable light. But before considering this judgment, it may be well to recall the various stages of litigation which have made Berliner "decisions" so familiar a heading, and "The Berliner Case," almost as frequently mentioned in the Courts of the United States as the celebrated case of "Jarndyce *v.* Jarndyce," which satirised our Chancery methods of an earlier time. A caveat describing Berliner's invention was filed on April 14th, 1877, and the application for the patent on June 4th of the same year. "Interferences" in the Patent Office delayed the issuance of the patent until November 17th, 1891. The owners claimed that it covered the essential principle of all existing telephone transmitters. Others interested in telephonic affairs, instead of contesting the patent on its merits, suggested that the existence of the patent was against public policy, and instigated the Attorney-General to bring a suit against the owners for the purpose of declaring the patent invalid. The Court of First Instance, presided over by Judge Carpenter, decided that the representatives of the inventor were responsible for the delay which had taken place in the Patent Office, and declared the patent invalid. This extraordinary verdict was assumed to have some political complexion, and was certainly against the weight of evidence. It was reversed by the United States Supreme Court, who declared the patent to be valid for all it might be worth. Its merits were the subject of consideration before the Circuit Court of Boston on November 7th, 1899, and on February 27th, 1901, Judge Brown declared that the patent was void for want of patentable invention, and the defendants, whose apparatus was alleged to infringe the patent, owed nothing to Berliner. An appeal against this judgment was immediately instituted, and it is the decision on this appeal which has now been given. Once again the patent is held to be valid, and once again it is held that no infringement has been made. The patent is valid, but limited to the use of the particular form described—metallic electrodes—which are, of course, not used in practical transmitters. Three judges constituted the Court, their names being Colt, Putnam and Aldrich, and their opinion is said to have been written by the first named. It is an able, admirably impartial review of the history of telephone transmitters in relation to science and patent law. It indicates the tendency in the higher Courts of the United States to decide patent cases rather on the broad grounds of the inventor's conception than on the narrow grounds of the instrumentalities patented. The real question at issue in the case was, "Who invented the microphone ?" And the United States judges have answered the question in the way in which the scientific world (old and new) had already answered it. Hughes invented the microphone, say the United States judges, but they say it in perhaps a far more complete way than it has been said in before. Berliner's claim to the invention of the microphone rests on his having applied for his patent a year before Hughes's discovery, and in that patent described the variation in resistance due to variation in pressure, illustrated the well-known disc and ball "electrodes in constant contact," and claimed "the method of producing

in a circuit undulations similar in form to sound waves by causing the sound waves to vary the pressure," between the electrodes, "and thereby increase and diminish the resistance of the circuit." It is the function of the microphone to vary the resistance by greater or less intimacy of contact. Hence the claim of Berliner to priority and protection. But the judges have gone deeper. They hold that microphonic action is not obtained by the resistance between two electrodes in constant contact. They quote from Hughes's paper to the Royal Society. They adopt his view that microphonic action requires a loose or light contact, and that the requirement was not met in Berliner's contrivance or description, and they apply to Berliner the test previously applied to Reis. "Our inquiry," they say, "is not whether the Berliner instrument became a microphone when properly adjusted, but whether Berliner first discovered the microphonic way of varying resistance, and made it known to the world in his caveat." As we have already shown, their inquiry leads them to the conclusion that Berliner did not discover the microphonic way of varying resistance, but that Hughes did.

It is impossible to read this latest judgment on telephone transmitters without recalling the controversy between Edison and Hughes, when the latter published his discovery and the former claimed it to have been included in his telephone transmitter. It is interesting, too, to compare contemporary comments on this controversy with the conclusions of the United States Judges 25 years later. "It appears to us," we said in our issue of July 1st, 1878, "that Mr. Edison, though very nearly discovering the full significance of the microphone, did not do so. He explained the real nature of the property which he had found to exist in carbon . . . . to be a diminution of resistance in the *mass* of the material. The discovery of the microphone limits it to an effect of the *surfaces of contact*. . . . . Thus it is that Prof. Hughes's discovery explains the true action of Edison's telephone, which is indeed a form, but a disguised form, of the microphone."

At this period the existence of another Richmond in the field was not known, Berliner's patent not having been issued and his claims not publicly put forward. Now that they have been judicially investigated, the Judges, in the course of their review of telephonic transmitter inventions, say, "Bell had supplied the current" (alluding to his battery transmission) "and had shown that it could be utilised by varying the resistance in a battery circuit, and what remained was to devise a better way of varying the resistance than was pointed out by Bell. This problem was solved by two discoveries, which are now embodied in every commercial telephone transmitter. The first was the discovery of the peculiar properties of carbon in varying electrical resistance, and the second was the discovery of the remarkable effects of sound waves in varying resistance at a loose contact between solid electrodes." Edison, they find, made the first discovery, and Hughes made the second.

Presumably the share of Clerac in discovering the peculiar properties of carbon in varying resistance was not brought before the Court, and in mentioning it now, for the sake of historic accuracy, we have no desire to detract from the credit due to Edison, for, next to the recognition of Hughes, the value of Edison's contribution to telephonic inventions is the most striking feature of the record before us. There is one important difference, and one only, between the commercial form of Edison's patent of 1878 illustrated in the judgment, and the commercial form of telephone transmitter used to-day. The carbon chamber, instead of being filled with a lozenge of plastic unelastic carbon, is filled with numerous detached particles, elastic in the mass, and performing the functions of a multitude of microphones by the variation of resistances in innumerable loose contacts. As designed, the Edison carbon transmitter did not in fact realise the inventor's theory, because the variable resistance was unelastic. But Edison made the most effective form, and when "the true action of Edison's telephone" was explained by Hughes's discovery, its improvement naturally followed.

In recalling a controversy, one of the participants in which is unhappily no more, it is but right to express our belief that the true nature of the facts was eventually recognised by both sides, and that Edison fully appreciated the independence and the value of that discovery of Hughes, which United States judges have now proclaimed.

CORRESPONDENCE.

Fuel Value of Refuse.

I noticed in your issue of 6th inst. an article by Mr. W. H. Booth on the "Fuel Value of Refuse," which, in my opinion, would have had more value had that gentleman taken the trouble to acquaint himself accurately with those matters which he criticises therein. He says: "Having seen Shoreditch . . . . . and its high hen roost full of thermal storage vessels."

As a matter of fact, there is but one thermal storage vessel at Shoreditch, and that is used less as a thermal storage vessel than as a feed-water heater and purifier, which functions it fulfils admirably.

Again, he suggests that if in Shoreditch a flat rate of 2d. per unit were charged for current used for power purposes, many little users would take such a supply of energy.

Again, I would remark that if he had only taken the most ordinary trouble to ascertain what was done in Shoreditch, he would find that 2d. per unit is actually the maximum charge for electricity supplied for power purposes in that district.

E. Manville.

Westminster, *February 10th*, 1903.

Mercury Vapour Lamp.

I have pleasure in enclosing you a copy of my Patent No. 4,261 of 1896, taken out with regard to above.

At the time of my invention, I had not heard of any lamp being made on this principle, and I was led to experiment in this direction by observing the brilliant spark obtained when using the mercury brake. I found the brilliancy was due to mercury vapour. I then placed some mercury in a vacuum tube, and found I obtained a most brilliant light. I usually employed a small transformer to take the current of the City circuit at 100 volts, and increased the pressure to about 2,000, but after starting, when the vapour became a conductor, of course, the pressure might be considerably reduced.

The lamp makers seemed to consider the necessity of altering the pressure in starting the lamp too complicated, and nobody seemed to care to take the matter up, thus leaving it for an American company to introduce.

I have come to the conclusion that the Americans are the only people of enterprise in the electrical world, and that an inventor who has anything absolutely new, is more likely to get his invention examined and eventually taken up in that direction, than in any other. Of course, the British public have then to pay the price.

I may mention that having become tired of waiting, and paying the annual fees on a patent which nobody seemed to want, I allowed the patent to lapse, so that a mercury lamp can be made free of royalty by all.

H. J. Dowsing.

London, *February 4th*, 1903.

Motor-Car Regulations.

While the control of motor-car speeds is still under discussion, may I call attention to the excellent effect produced by the enforcement of the "rule of the road" at sea, in the prevention of collisions, and consequent loss of life and damage to property.

No amount of bye-laws or policemen can control motor-cars, nor is it right to differentiate between them and other items of traffic. The butcher's cart, the bicycle, the motor-car, and the pedestrian are all equal in the eyes of the law, and must be treated as such. No one section may be persecuted or treated as suspects, but each individual, of whatever class, must be held individually responsible, and the penalties should be severe. Loss of life should be treated as manslaughter.

The "rules of the road" above referred to resolve themselves into three simple principles :—

1. The faster-moving vessel must under all circumstances get out of the way of the slower and less manageable.

2. All vessels passing each other must do so on the correct side—viz., to the right in meeting, and to the left in overtaking.

3. Special rules for narrow channels.

These rules, if adapted for road work, would stand :—

1. Identical in every respect as for marine work.

2. The same, reversing the passing sides.

3. If any vehicle exceeds the speed of 8 miles an hour in the streets of villages or towns, or 4 miles an hour on all main road crossings, such vehicle to be held responsible for any accident that may arise ; in the case of bye-ways, each vehicle to be held responsible on emerging on to the high road.

All statutory speed limits to be abolished.

All vehicles that are capable of exceeding 10 miles an hours to be numbered and registered, such number to be proportionate in size to the speed attainable and to be legible on the lamps at night.

All transgressions of the above bye-laws should place the offender *ipso facto* in the wrong.

A scale of penalties should be drawn up on a rather severe basis, applicable to the whole kingdom, leaving no option to the magistrates but to inflict them on approved evidence, and in the course of a few months the vast majority of drivers would exercise reasonable care and caution, and the few scorchers that make some roads a terror would very soon have to smart for their fun.

Any wilful obstruction can be dealt with under the existing law.

Hooters and whistles for frightening people out of the roadway should be discouraged, as it is the duty of any vehicle to slow down if there is any obstruction.

I am persuaded that the above lines are the only ones possible for securing the interests of all parties and doing away with the sore feeling which at present exists in the minds of a large portion of the public.

Equality.

Country House Lighting.

Having had some little experience in the use of accumulators, and seen many in use at the houses of my friends, I wish to call the attention of the profession to certain points which it seems to me are too generally neglected. I allude to the prevalent under-supply of accumulator power, and to the bad arrangements for charging. I will take these in order :—

1. The amount of accumulator power required. In order to keep accumulators in perfect order, it is necessary that they should not be unduly overcharged or unduly exhausted. The first gradually converts the lead grids into oxide and makes them rotten, the latter misuse causes them to buckle and prematurely to decay.

Having regard to the fact that the usual figures given in vendors' books relate to brand-new accumulators, and that the working figures will usually be less ; also to the fact that most gentlemen in country houses in the summer prefer not to run the engines more than twice or thrice a week, I would suggest that for every candle-power of lamps *installed* (I do not mean practically used), power should be provided to burn for nine hours. This will give an ample margin, but not too large a margin, and will enable the exigencies of a ball or dinner to be easily met. If this figure is adopted, taking 4 watts to the candle, we shall require to provide 36 watt-hours of accumulator for each candle-power. So far as I can ascertain, the cost price of accumulators will be about 1d. per watt-hour of storage capacity. Thus, then, for a small installation, say, of 1,000 candle-power, we should require to spend on accumulators 36,000d. = £150, or 3s. per installed candle. I find, however, that engineers do not usually allow this figure. They are too much afraid of frightening clients. Not being myself connected with electricity in any trade way, but treating the matter solely from a consumer's point of view, I would entreat my brother engineers not to be afraid to tell the consumer the truth. It will be far better in the long run. If you deceive him, or give him an inadequate plant, it is certain that, in order to have it renewed, he will go elsewhere. I should like very much to see the figures I have suggested corrected and criticised by those who are experienced in the business.

2. The next point I wish to emphasise is the use of low voltages. The advantages of this plan are :—(*a*) That you can have a slow-running dynamo and thus avoid heating. It is true that, being large, it costs a little more, but this is more than counterbalanced by saving in wear. (*b*) The sparking at the brushes is much less. In fact, with 50 volts, if the commutators are occasionally smoothed off with fine sandpaper, you never have any sparking to speak of. (*c*) There is less danger from bad insulation. I admit that your wires and mains must be bigger, but this is an absolute

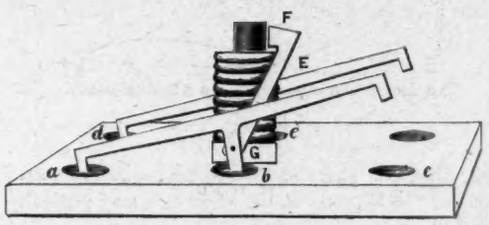


Fig. 1.

advantage. The small single-wire leads too often employed are a constant source of trouble by breakage. I would thus earnestly plead for liberality in wiring.

3. The next point I would urge for country house lighting is the use of small lamps. I am aware that in point of theoretical economy big lamps are better than small ones, but in practice ten 5-c.p. lamps light a room better than four 16-c.p. And the reason is that the eye can bear to look at very small lamps without ground glass shades; they look like that most beautiful of all lights, the old-fashioned naked candle, under the light of which our ancestors used to dance and dine. Nothing is more beautiful than an old-fashioned chandelier fitted with small lamps—not one of the modern heavy concerns, but one on the Venetian plan, designed upon the model of a cobweb sparkling with drops of dew. Diamonds also never show at all except under naked lamps. Under frosted glass they look like bits of glass.

4. The fourth point is to avoid giving too much light. I have seen nice country houses quite spoiled by the introduction of too much light. In certain places, as a salôn or billiard room, considerable illumination is desirable, but many rooms, such as studies, or halls, or corridors, have their romance quite spoiled by glaring lights in glass trumpets.

5. The last point to which I would draw attention is the destructive mode employed at present to enable lights to be run while charging is going on, by cutting out part of the accumulators. I need not insist on the fatal results to the accumulators, every engineer knows them. The alternative is one proposed by Sir David Salomons, years ago, and now apparently forgotten, viz., to insert five unpasted resistance cells, for every 27 cells employed, and to send the house current though them in series with the accumulators, while the dynamo is switched on to the accumulator terminals. He describes in his book very complicated automatic switching contrivances which, though complicated, have been at work at his house for years with perfect success. As, however, we are not all possessed of large fortunes, permit me to conclude by describing a small apparatus designed for my own installations, which works very well. It is a semi-automatic tumbler switch, with arms dipping into mercury. The sketch, fig. 1, will make it clear. E is an electro-magnet, round which the current from the dynamo is driven when the dynamo is switched on to the accumulators ; F is an armature working on pivots at G, which is held up by attraction, but which, when the current ceases, falls away. There are five mercury cups, *a*, *b*, *c*, *d*, *e*. *a* is connected to the positive dynamo terminal, *b* to the positive end of the accumulators, *c* and *e* to the positive house main, *d* to one end of the resistance cells, the other end of which joins the

positive end of the accumulators, as shown in the following diagram, fig. 2. A 10-volt lamp is put on to the terminals of the five resistance cells, or a bigger lamp, if more are used. Of course, a less or greater number of resistance cells can be used, but 5 to 27 answers the usual charging conditions.

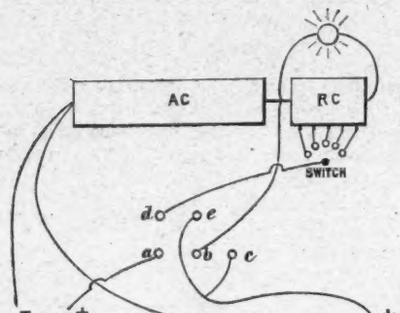


Fig. 2.

At first, when the charging begins, two resistance cells will be enough. As it proceeds, the whole five may gradually be switched in.

The mode of using the apparatus is as follows :—When the dynamo is at rest the armature F falls over, and *b* is united to *c*. The house is thus lit from the terminals of the accumulators. If the dynamo is run, as soon as the voltage is sufficient, F is raised by hand, so as to disconnect *b* and *c*, and to switch *b* on to *a* and *e* on to *d*. The dynamo is thus put on to the ends of the accumulators, and a current begins to run, which holds F in its place. At the same time the house is now switched on to one end of the accumulators and the other end of the resistance, and the proper voltage is thus secured without any switching out of the accumulator cells. The resistance lamp at once is lit. The house-current, of course, charges the resistance cells, but as they have no paste, only a very thin coating of oxides is formed on them. If by any chance a belt breaks or the dynamo current falls below a certain figure, the armature F falls away and the current is broken, and can only be renewed by the engineer. At the same time, however, in falling, the head F makes contact with an electric bell circuit that warns him something has gone wrong. I think this cutting-off of the dynamo once and for all in case of a breakdown, better than the rick-rock in-and-out system which puts it on again when the voltage has again risen to the proper quantity. A failure of the current ought not to be automatically condoned, but ought at once to be brought to the notice of the person in charge. The system also has the great advantage of simplicity. Of course when he stops the engine purposely the same result occurs, the resistance is cut out. The charge which the resistance cells have received then gradually expends itself on the 10-volt lamp, which burns for a time and then dies down and is gradually extinguished. This prevents further formation of the resistance grids. The action is so instantaneous that in my installation you can only just see a wink for an instant, the voltage of the house lamps being just the same as before.

The waste of electricity is small, as it only occurs when the house lights are on and the engine also running.

I offer this plan to the profession for what it is worth—it acts well and is not the subject of any patents.

Henry Cunynghame.

Charges for Electrical Energy.

Your correspondent "G." observes that I am ignorant of all that has ever been written on this subject, that what I myself have written is ancient history, that my conjectures are valueless, my analogies wrong, that the tenor of my article is irresponsible, that I raise quibbles and have no grasp of the subject, that I indulge in empty platitudes and wild guesses, am neither practical nor experienced, and that I have contributed a string of disjointed opinions devoid of either logic or intelligence.

It is by surrounding his arguments with this wall of politeness that "G." seeks to convince your readers that the position of the maximum demand system is unassailable.

Strong arguments do not usually need such fortification.

There is nothing disastrous in the records of the Burnley undertaking, as a reference to the figures will show, and there were doubtless many causes that contributed to the temporary reduction in output independent of the change from maximum demand to flat rate. For example, the facts quoted by "G." might be used to show that there were probably more than an average number of hours of sunlight during the period in question, and no progress would be made by arguing around an individual instance of this kind.

I did not state that the charge to the consumer cannot be based upon the cost of production—which would be absurd—but that it cannot *only* be based upon that; the cost of production necessarily being the chief factor in fixing the selling price under any system.

The problem is quite easy when you consider the consumers as a whole, and the complications and difficulties only arise when you consider them individually.

The flat rate is calculated to provide a profit on the *total turnover*, whereas the maximum demand system aims at making a profit out of *each individual consumer*, and though this system is admittedly perfect *in theory*, it is, in my opinion, unsatisfactory *in practice*, the proof of which lies in the fact that it has been tried and found wanting in numerous towns in England, or why is the alternative flat rate now offered in so many cases?

There is nothing whatever complicated in the theory of the maximum demand system except to the lay mind, but as I stated in my article, it is exceedingly complicated *to operate*, and I am not surprised to learn that the further complication of its operation in conjunction with a time switch exists only in the minds of electrical men; that it may remain there is a consummation most devoutly to be wished.

In any case, the mere fact that a change is contemplated is only additional evidence that the maximum demand system as now operated is found to be undesirable.

If a product costs threepence to produce, I cannot see that any great amount of mental exercise is necessary in determining the price at which it must be sold in order to provide a fair average profit, and why that straightforward problem should lead to the complexity of differential rates, I also fail to see.

Your correspondent winds up by saying that the majority of engineers in this country are not responsible for the conduct of the business under their charge, and that they are in need of "logical and intelligent instruction" on the subject of "economics," which he goes about the country giving them, and in order to prove to your readers that he is both "logical and intelligent," he adopts the peculiar course of hiding himself behind the letter "G." in order to fire off a volley of unsubstantiated abuse, which, mixed with a few adjectives, would do credit to the oldest inhabitant of a London cab rank.

It is perfectly clear from the tone of his letter that "G." is not disinterested, and it is therefore possible that he has been tempted to write against his own convictions.

Chas. O. Bastian.

London, *February 17th*, 1903.

Electrolytic Meters.

Without wishing to cast any reflection of doubt upon the figures and curves sent to you by "Electron," we cannot help expressing our regret that he should have adopted a *nom de plume*. His results are no doubt accurate for the particular meter that he has tested, and that being so, we fail to see any reason for his being unwilling to reveal his identity and allowing us the opportunity of showing him to what the *abnormal* drop in volts is due; this may be through damage to the electrodes, a bad contact, or some more obscure reason that we cannot determine without examining the instrument. This he must acknowledge is fair, and that we cannot reasonably be expected to defend even the *normal* performance of our old 10-amp. meters is evident from the fact that those we are now manufacturing have *double the platinum surface* that we provided hitherto,

and we have made this change because we ourselves were dissatisfied.

In the curve, however, the rapid rise from two to three volts and the gradual increase thereafter indicates the presence of a "nigger," whose whereabouts we are sorry we have no means of investigating, owing to the anonymity of your correspondent; but, under any circumstances, he will find that the volt drop decreases materially as the electrolyte "ages," and it is possible that he has not tried this. Moreover, if the volt drop is materially decreased by the addition of acid, that would prove that he has not put in the correct quantity to commence with, and writing in the dark we can give him no further hints.

That the voltage curve for a 2½-amp. meter is almost identical with that shown in the *abnormal* diagram, is an absolute misstatement, and we are afraid that "Electron," without intending to be unfair, has jumped at the conclusion and not actually tested a 2½-amp. meter.

By his own showing, moreover, the drop would only just exceed 3 volts at full load, and every engineer knows that a meter is very seldom worked under those conditions in practice, though temporarily it may be heavily overloaded.

We would remind "Electron" that this discussion is hinged entirely on small size meters, and in these 200-volt days a 10-amp. consumer means fully 70 8-c.p. lamps all alight at once, so that the result of a test on a smaller meter would have been more to the point, though our larger meters are eminently suitable for motor circuits, where the volt drop is of less importance.

Finally, we must point out that your correspondent is not quite consistent, because in the same sentence he both praises the accuracy of the Bastian meter and deprecates its "efficiency."

Surely *accuracy* is the all-important factor in the *efficiency* of a meter, and unless the accuracy of any two is identical, their respective efficiencies cannot be compared by ascertaining the energy that is absorbed in their operation.

We contend that, unless a meter is uniformly accurate throughout its range, it is inefficient and untrustworthy, and on this view we base our contention that the Bastian meter is the only "efficient" meter on the market for small consumers of continuous current.

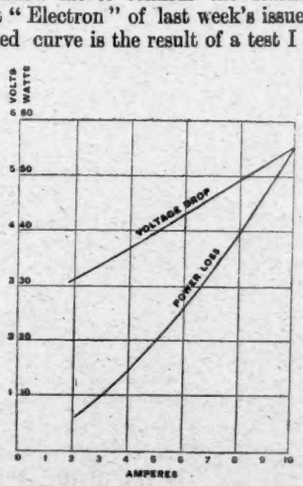
Can "Electron" define the efficiency of a meter that refuses to start with an 8-c.p. lamp?

The Bastian Meter Co., Ltd.
Chas. O. Bastian, *Managing Director.*

London, *February 17th*, 1903.

Will you allow me to confirm the statements of your correspondent "Electron" of last week's issue.

The enclosed curve is the result of a test I have made on



a Bastian meter, and at its full load, which was 10 amps., there was a voltage drop in the meter of 5·5 volts.

Looking at this from the point of view of an average consumer—his bill is 5·5 per cent. more than it should be for the light he gets as energy, besides having to put up with his lamps burning dull when he has them all on, by reason of the enormous drop in the meter.

The Bastian meter may be, as is claimed for it, "dead accurate," but this is surely no reason why a consumer should have to pay 5 per cent. of his bill simply for the metering of his supply and get bad light in the bargain.

Glimmer.

February 17th, 1903.

The Wiring of Buildings.

Mautby Hill's suggestion is good, but I think it is more the duty of the supply authority to employ a thoroughly practical electrician to do the work that is in many cases done by pupil assistants, commonly called "inspectors." It is obvious that these assistants, mostly due to their inexperience, cannot reason out "faults" other than those directly pointed out to them. A suggestion which I should like to make is, that the supply authority make more frequent periodical tests and *inspections* of consumers' installations, especially on certain of the tubing systems. If this is done we may be able in time to do away with what seems to have been an unforeseen "death trap."

G. H. Bell-Jaquin.

In answer to your correspondent "Foreman," I can quite endorse the remarks made by Mr. H. Lea and others. Damp atmospheric conditions have a decidedly bad effect on installations, especially new jobs; but the inspector cannot be expected to test jobs on fine days only, any more than a shipping company can be expected to take a boat that has been built for fine weather sailing, as both, in practice, have to withstand the most wretched weather conditions. The only remedy, therefore, is for the contractor to make his installation to pass on a wet day.

Until there is a decided improvement in class of material and workmanship, installations will continue to be affected, and contractors to plead the excuse of dampness in buildings. There are a few points that must be observed by contractors if they wish to secure a good test. A good class of wire must be used, not wire with small covering of rubber and plenty of braiding, which acts as a retainer of moisture gathered in piping, but rather the other way. Care must be taken by workmen to strip this outer covering well back off terminals. Slate bases, unless bushed with ebonite, are an absolute failure when testing is going on; they are not only responsible for a low earth test, but are liable to cause a great amount of trouble by insufficient resistance between poles of the main switch. I was testing a job recently which proved to be low, and naturally I turned off the main switch; but the fault was still shown on the instrument, which caused me to disconnect the company's main cut-outs and meter, thinking, as pointed out by Mr. H. Lea, it might be on these; but when this had been done, the fault was still on, so, knowing the faulty nature of slate, I had the main switch removed, and the fault was immediately cut off. Now, naturally, one would have been led to condemn the mains, when, really, it was the effect of a bad circuit through the base of the main switch.

This also applies to slate distributing boards. I have found it impossible to get a correct test of any one circuit on one of these boards without disconnecting it, owing to the leaky nature of slate. Another cause of bad tests is the lamps, which many Corporations insist on being in before testing. These should be removed from all outside brackets, &c., which are in contact with earth, or they will assuredly bring down the test without the aid of a little dampness.

Motors, as pointed out by "Megohm," are unfairly condemned by supply companies and Corporations, and contractor should not be charged for the second test until the motor has had a day's run, as he is not, in many cases, directly responsible for the insulation resistance of it, and it is next to an impossibility to get over a megohm to earth, using a 500-volt set, with the frame of the motor efficiently earthed.

But with lighting installations it is an entirely different matter. The contractor is directly responsible for bad work and tests, and these should and can be guarded against if experienced men and foremen are employed, together with good material. As for the 10s. 6d. charge for re-tests, this is not

simply to pay the wages of the inspector, but to compel indifferent contractors to put their installations on a sound basis and remove all faults before calling in the company's inspector. In the past I have experienced the nuisance of having not only to find out the earthed circuits, but to test for continuity, and assist them in general to put the job right before I could connect it. Of course I am alluding to a certain class of contractors, who have by far the greater hold in all large towns (the jerry wiring contractors), who take jobs at such a low figure, that they cannot afford to keep a foreman or buy a testing set.

I can quite see what "Megohm" is driving at, and I have no doubt it would suit contractors admirably to hire the inspector and set by the day, but who is going to pay the wages during the slack season, as it would necessitate three times the number of testers?

I think that a good plan would be for small contractors to subscribe together and employ an experienced man to go over all their jobs with a testing set, and put them in order, so that when the company's inspector is called in, there will be no delay due to bad tests; this would hurry connection to mains, and thereby benefit contractor, company and consumer.

Inspector.

While holding no brief for the jerry wireman or his methods, as a contractor who has had to compete against free wiring and contracts carried out by the supply company at net cost for materials and labour, I can realise the temptation to substitute inferior material and shoddy workmanship in order to at least make a living. The conscientious master has no alternative but to go to "fresh fields and pastures new," and thank the powers that be that England is not yet in the hands of monopoly, and that there is still fair trading and opportunity for good work to realise its proper value.

Surely there is sufficient competition among contractors to safeguard the interests of the public, without adding to it in this manner? A wealthy company can afford to forego any profit on wiring for the sake of the profit to be made out of the sale of current, but I never have heard of a contractor who could do work at cost price.

I think the suggestion of inspection by the Fire Insurance Companies to be a sound one, and should be willing to pay in support of a competent man; it would give a greater assurance to one's customers, and effectively prevent unsound work.

Robert.

Mr. G. Stegman does not care for a practical electrician to come into the job, as he states that what the practical electrician condemns would be found quite in order by the inspector of the respective supply companies, and would lead to the question, Who is master?

I might ask Mr. Stegman how is an inspector to know how a job is installed unless repeated visits are made during the operations, for, be it known, that a nice polished board and brass cap switches and nice ceiling fittings oft-times cover a multitude of sins?

If Mr. Stegman is a practical man, he must know that it is a very rare thing for a fire inspector to visit a job when in course of installing; in fact, I have never known of such a visit in my 10 or 11 years' experience in installation work. Supply companies generally do not hold themselves responsible for the quality of work.

The Corporation of Brighton's Electricity Rules, No. 9, read thus:—"The Corporation are not responsible for the efficient and proper execution of any work on the consumer's premises other than that done by their own workmen."

Then, again, in the Phœnix Fire Rules, page 4, we read the following:—"Although it is necessary to have tests taken of an electrical installation, it is an error to suppose that if they show good results they must prove the installation to be a good one, and safe. Under certain circumstances it is possible for the tests to be very high, and yet the electrical work may have been scamped and the installation be dangerous. Trust, first, to the manner in which the whole work has been put in, and next to the tests."

Mr. Stegman is afraid there would be friction; I myself also believe there would be, but only with a certain class; that is, the jerry wireman and his master, as "Fair Competition" rightly calls them. The firms who pride themselves on the good work they put in would welcome the inspector who understood their work thoroughly, as they would know that their work would be appreciated. No doubt some of the fire rules are superfluous, but a thorough practical man would be able to draw the line without endangering his employers. I am pleased to see that "Fair Competition" thinks my suggestions good, but I cannot think with him that the contractor ought to help pay for the inspector, as it is clearly the interests of the fire insurance companies that would be at stake. In fact, it is the duty of the fire office to see that work is carried out in accordance with their rules, as valuable lives are oft-times placed in jeopardy, and I trust that something will be done in this way to stop the jerry wiring that is being done to-day.

Mauthy Hill.

Brighton, *February 10th*, 1903.

With respect to the testing of the insulation resistance of the wiring of buildings (and incidentally of other tests of insulation resistance), I may mention that I find a book of records of tests very useful for purposes of reference, and for comparing the results obtained at different places, and at the same place under different conditions.

The columns of each page of the book are headed Date, Name, Description, Reference, Insulation Resistance, Number of Lamps, Voltage, Current, Minimum Insulation Resistance Required by Phœnix Rules, Test Factor, Remarks.

The principal feature in the above is what I call the "Test Factor," which is the number of times the insulation resistance recorded on test exceeds the minimum given by the Phœnix rules. Thus, if the minimum insulation resistance by the Phœnix rules for a building having 500 lights is 30,000 ohms, and the observed insulation resistance is 300,000 ohms, the "test factor" would be 10.

I find this a very good way of rapidly comparing tests, whether of the whole of a building, or of any circuit. It is, of course, applicable also to comparing the results of tests of motors, &c.

With good work I find no difficulty in getting "test factors" of from 5 to 50, or even more, with all fittings in place. The condition of the building, and the state of the weather materially affect the insulation resistance as noted by your other correspondents.

W. H. Thornbery.

Birmingham, *February 17th*, 1903.

Electrically Operated Printing Machinery.

I was much interested in the description of the Ward-Leonard system in a recent issue of the Review, and a subsequent visit to Messrs. Lloyd's machine room added still further to my acquaintance with the system. The point which interested me most was the claims made for the efficiency of the apparatus and the small starting current, the impression being that it was matchless. No doubt the rheostatic losses are small, as is pointed out, but that is not the whole story: the total losses are different, and appear to reach a much higher figure. As with all similar systems, the main motor efficiency will vary with the load; but the motor-generator losses have to be added to the main motor losses, and take the place of rheostatic losses in other systems.

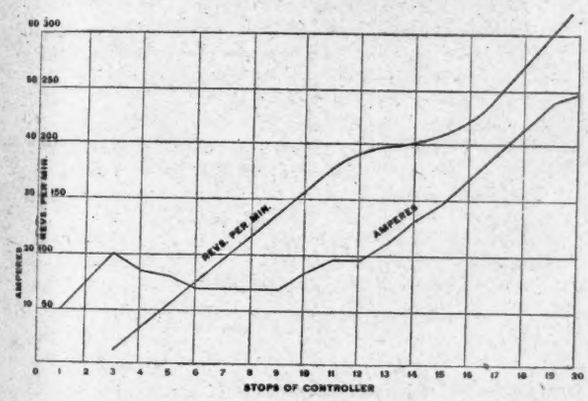
Assuming that the combined efficiency of the motor-generator is 82 per cent., and that it supplies half the total power at full load, there will be a loss of 7½ H.P., or 5·4 KW., in this auxiliary plant; this at the City rate of 2d. per kilowatt-hour means 10·8d. per hour, apart altogether from the main motor losses. It is at this point that such systems as the Holmes-Clatworthy, Bergmann, Bullock and others are most economical, and certainly it is a feature of considerable importance when one bears in mind that 95 to 98 per cent. of all their energy paid for by meter is used by the press at

or near full load, the units consumed in the "making ready" process being infinitesimal.

At other loads, such as half load, where the motor-generator does not supply any energy, but is, however, running light, its own losses cannot be less than 2 KW., and may be more. It appeared to me, an unsophisticated onlooker, that the motor-generator was kept running all the time during the making-ready process, thus the energy lost in this would soon reach a respectable figure.

Then again, the motor-generator at full load boosts the line voltage to double its value; what would it be, say, in Glasgow, with 500 volts on the outers and this boosted by another 500 volts? One should certainly sympathise with those operating a press directly connected to a 1,000-volt direct-current motor. Even if the main motor were on one side of a three-wire system at 250 volts, one should transfer his sympathies to the mains engineer, who would have a 60-H.P. motor running at, say, half-load on one side of his network with a motor-generator taking, say, 2 or 3 KW. to balance it. Indeed, would any borough engineer tolerate it?

The gain which offsets these losses must be very great, and worth paying a decent sum in operating expenses in order to obtain it. It is summed up as effective and economical speed control; about the effective nature of the control there can be no doubt, the speed control, apart from



other considerations, being as perfect as the wit of man can devise, yet the employment of a motor-generator to obtain these results is, I think, not quite the best thing. To show that effective speed control may be obtained without the intervention of a motor-generator, I give two curves from a Bergmann tandem motor of 30 H.P. driving a newspaper press. There are several of these in use in this country—Edinburgh, Manchester, Bristol, &c.; some have been in use nearly two years. The method of control consists of a series-parallel arrangement with a rheostat at very low speeds only, the losses in which never reach 2 KW. The motor appears to be a double commutator machine, but it really is two machines with independent field and armature systems, all carried on one shaft and by one pair of bearings. It is, in fact, more remarkable for what it is not than for what it is. The speed curve leaves little to be desired. It is almost a straight line, so also is the current; while as for starting current, the most critical central station engineer will not quarrel with a 30-H.P. motor taking an initial current of 10 amperes, which can be "inched" around on less than 20. There are no violent jerks in the speed, and the system has been in use in this country for a considerable period in newspaper offices both in Scotland and in England, producing morning and evening papers with most satisfactory results.

The tandem system from which the accompanying curves were taken is manipulated in the same manner as the Ward-Leonard—viz., with one hand-wheel.

These few notes are not penned in any hypercritical spirit, as the name of Ward-Leonard has been long and successfully connected with the problem of economical speed control, but more to show that there are other means of securing economical speed control, and that it can be done effectively without a motor-generator; while you, Mr. Editor, will, I think, agree that Ward-Leonard is not the only pebble on the beach.

Electra.

LEGAL.

The King v. Mayor of Dover.

In the King's Bench Division on Tuesday the case of the King *v.* Mayor of Dover (*ex parte* Bradley) came before a Divisional Court consisting of the Lord Chief Justice, Mr. Justice Ridley and Mr. Justice Darling. In this case a rule had been obtained on behalf of Mr. Bradley, calling upon the Mayor of Dover to show cause why he should not hold a poll of owners and ratepayers in reference to the scheme of the Corporation to take over and pay for the undertaking of a local electric light company and themselves light the town by electricity. The circumstances leading up to the case were detailed in our January 30th issue. On Tuesday, after hearing Mr. Macmorran on behalf of the Mayor, and, without calling upon the other side,

The Lord Chief Justice said he was clearly of opinion that the rule must be made absolute. He was by no means clear that a demand could be withdrawn after the meeting had separated, but he did not wish to express any opinion upon that point. He was of opinion that an effective demand was made by Mr. Bradley, and effect ought be given to it.

Mr. Justice Ridley concurred.

Mr. Justice Darling was of opinion that a demand for a poll after it had been accepted, could not be withdrawn except by the consent of the whole meeting; otherwise all manner of collusion might arise.

The rule for a *mandamus* to take a poll was made absolute and peremptory in the first instance, but without costs.

Barlow v. Manchester Corporation.

This case came before the Chancery Court of Lancashire in Manchester on 12th inst. From the *Manchester Guardian's* report we gather that this was the second action against the Manchester Corporation for an injunction and damages in respect of injury to property said to have been caused by vibration created by the generation of electricity. In the first action, which related to the Bloom Street station, the parties on Tuesday last week agreed to terms for the adjournment of the trial until January next, in order to give the Corporation an opportunity to complete certain experiments upon which they are engaged, with a view to preventing the vibration complained of. The second action related to the Dickinson Street station. The plaintiff, Mr. John Emmott Barlow, M.P., of Torkington Lodge, near Stockport, asked for an injunction to restrain the Corporation from so working their engines, dynamos, and other machinery at their electricity works, and from so carrying on their said electricity works at Dickinson Street, Manchester, as by reason of noise and vibration or otherwise to cause damage to the plaintiff's premises in Dickinson Street, adjoining the said works, or any part thereof, or to interfere with the use and enjoyment of the plaintiff's premises by the tenants thereof for the purposes of their businesses of packers and shippers, or so as in any way to cause annoyance or danger to such tenants or the persons frequenting the said business, or so as to cause any damage to the said premises, or any injury to the plaintiff as the owner thereof. The plaintiff was represented by Mr. Warmington, K.C., and Mr. Grant, and the defendants by Mr. Moulton, K.C., and Mr. Maberly.

Mr. Warmington, on the case being called, said he was happy to say that the parties had come to terms.

Mr. Moulton intimated his acceptance of these terms.

The order agreed upon was in these terms:—Defendants admitting that at the time of the writ there was sufficient vibration in fact due to the use of the machinery of the Corporation for electric lighting to give right to damages and costs of suit, and undertaking to pay rent quarterly at the rate of £850 a year from Lady Day, 1902, for the period of the adjournment (provided the premises remain so long unlet, and then only for the deficiency), and consenting to an order for taxation and payment of plaintiff's costs up to and including to-day, and undertaking to consent at the adjourned hearing to an inquiry as to damages on the basis that the damage shall be assessed in respect of the total vibration and not with regard to that caused by the use for electric lighting only, unless the defendants establish at the hearing that they were entitled at the date of issue of writ to generate electricity for both lighting and traction without liability for any nuisance occasioned thereby without negligence except so far as negligence may be proved as against the defendants, and undertaking that the defendants will take party and party costs should they be successful in the issue as to injunction on the adjourned hearing.

The hearing stood adjourned until January, 1904.

Rogers v. Mackie.

At the Watford County Court on Monday this case came before his Honour Judge Marten.

The plaintiff, an electrical engineer, of Watford, sued Messrs. Mackie & Co., Golden Lane, London, also electrical engineers, to recover £7 10s. in respect of an alleged defective commutator.

Plaintiff said that he purchased a commutator from defendants to put in an electric light plant. The commutator, it was said, should be made of sections of a certain thickness, whereas this was of thinner sections riveted together. When in course of time the commutator was "turned down," the rivets fell out, and the next

time the turning down process had to be done the commutator, plaintiff contended, would probably fall to pieces. The way defendants had wrongly built up the commutator had, plaintiff alleged, shortened its life by one-half. He had paid £14 7s. 8d. for it, and now claimed £7 10s.

William Mackie, of the defendant firm, said the plaintiff told him that the work was urgent. The rivets were put in to hold the pieces together whilst they were being formed into a whole. It was absurd to say that when the rivets had gone the commutator would fall to pieces, because the rings would hold it together. The amount mentioned by plaintiff included other work, and the actual value of this commutator was about £4 15s.

Judgment was given for the plaintiff for £4, with costs.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Feb. 18th, 1902.		Week ending Feb. 17th, 1903.	
Adelaide	Value £402	Alexandria	Value £45
,, Teleg. cable	249	Amsterdam	505
Amsterdam	88	Auckland	762
Auckland	80	Bombay	141
Bangkok	26	Buenos Ayres. Teleg. mat. ..	895
Bombay	400	,, Teleph. mat. ..	880
Buenos Ayres. Teleg. mat. ..	289	Calcutta	842
Calcutta	400	Cape Town	154
,, Teleg. cable	100	Channel Islands	9
Cape Town	413	Durban	1,301
,, Elec. cable	760	,, Teleg. mat.	6,200
,, Elec. tramway mat.	955	,, Teleg. plant	6,961
Carlskrona. Teleg. wire ..	467	Flushing	170
Cocos. Teleg. apparatus ..	241	Gibraltar	10
East London	274	,, Teleg. mat.	12
Fremantle	410	Havre	60
Ghent	10	Hong Kong	88
Gothenburg. Teleg. wire, 132 cwt.	—	Inhambane	10
Grenada. Telephones	14	La Plata. Teleg. mat.	102
Hamburg	27	Lyttleton	56
Jamaica. Elec. cables	4,219	Madras	18
Melbourne. Teleg. wire ..	1,750	Malta	25
Monte Video	40	Melbourne	105
Nagasaki	20	,, Elec. motors ..	457
Otago	80	Monte Video	70
Para. Teleg. cable	53,000	Otago	41
Perth	140	Perth	450
Port Said	25	Port Elizabeth	40
Reval	204	Port Said	10
St. Petersburg	10	Rio de Janeiro. Teleg. mat. ..	225
,, Teleg. wire ..	100	Singapore	59
Shanghai	637	Sydney	822
Sydney	437	Wellington	60
		Yokohama	255
Total ..	£66,162	Total ..	£21,180

Foreign Goods Transhipped.

Fremantle. Elec. mat. ..	Value £188	Durban. Elec. mat.	Value £25
		Gothenburg. Elec. apparatus	29
		Total	£54

Safety Couplings for Arc Lamps.—The accompanying illustrations show a safety conductor coupling for arc lamps. The coupling can be firmly connected to the lamp, at the same time enabling the latter to be cleaned and re-carboned without danger to the attendant, the pulling down or opening of the lamp disconnecting it from the current conductor. The couplings are made for use in the open air with an "umbrella" (fig. 1) as a protection against rain, and for indoor use without umbrella (fig. 2). By the use of suitable connections the couplings may be supported

Fig. 1.

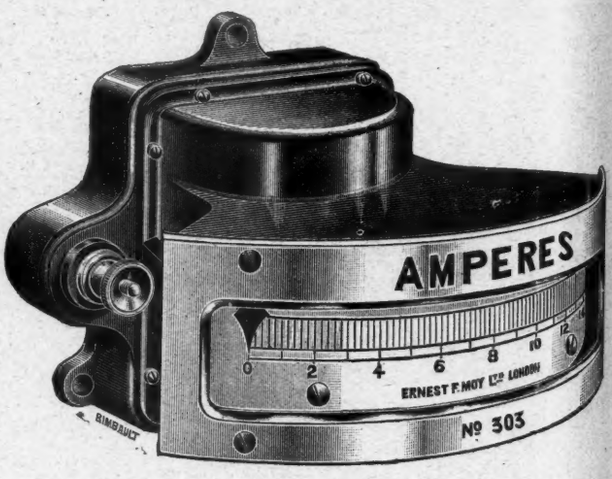
Fig. 2.

Fig. 3.

Fig. 4.

from brackets or sheet masts. In case the bracket has no special pulley for the lamp-supporting cable, a pulley block (fig. 3) is recommended, which has the advantage that the current conductor can be fixed inside the tubes of the bracket. The clip (fig. 4) enables the lamps to be connected to the supporting cable without necessitating any splicing, a great saving of time in erection being thus effected. Another clip is supplied with an insulator to connect the cable to counter-balance weights. The insulated clip (fig. 4) is designed for use with non-insulated lamps, or with insulated lamps working on circuits of a voltage of over 220—a double insulation being thus in the latter case obtained. The above devices are supplied by the Siemens Electrical Appliances Co.

Moy's Measuring Instruments.—A new instrument catalogue has been brought out by Messrs. Ernest F. Moy, Ltd., of Camden Town. It describes a new type of d'Arsonval measuring instrument for continuous current which they are just putting on the market. The makers have tried to obtain compactness, as shown in the illustration, in order to economise space when setting out a switchboard, and this will be appreciated from the fact that, although the scale markings have a length of 6 in., a series of instruments may be placed in a horizontal line at 8-in. centres, or in a vertical line at 6-in. centres, thus offering a great advantage as regards space occupied when compared with an ordinary round dial instrument with a scale of similar length. The instruments are claimed to be extremely dead-beat in action, accurate and reliable, and to have no errors due to hysteresis. In the ammeters the temperature error is very small, and the drop required across the



shunt for the full scale reading is about ·06 of a volt only. In the voltmeters there is practically no temperature error, as the amount of copper in circuit is only that used in the moving coil itself, which has a drop across it of less than 1 volt for all ranges, and it only requires a current of about ·01 of an ampere for full scale reading. Ammeters up to and including the 50-ampere range are fitted with self-contained shunts; for higher ranges a separate shunt is supplied. Two single flexible leads of different colours, each 4 ft. 6 in. long, with suitable connectors at the ends, are supplied with each shunt; the length of these leads must not be altered, as they form part of the resistance of the ammeter. Where longer leads are required, these can be supplied at a slight extra cost, but they must be adjusted to the ammeter. Voltmeters up to and including the 300-volt range are fitted with internal resistances; for higher ranges a separate series resistance box, having a resistance nine times that of the voltmeter, is supplied. The instrument may be used without this series resistance box for measuring pressures up to one-tenth its full range.

Parliamentary.—The following Scotch Bills came before Mr. Campion recently for proof of compliance with Standing Orders:—

Lanarkshire Electricity and Refuse Destructor.—This is a Bill to make provision with regard to the supply of electricity, and of the destruction of refuse in special lighting and sewerage districts in the county of Lanark. The Bill provides that electric lighting provisional orders may be obtained by the County Council who may delegate their powers to district committees.—The Standing Orders were found to have been complied with.

Edinburgh and Queensferry Tramway.—This Bill incorporates the Edinburgh and Queensferry Tramway Co. with a capital of £72,000; the first directors being John Jordan, John Cowan, H. D. Laurie and others. Power is given to take land in Edinburgh and Dalmeny for generating stations. There are about 8 miles of tramways proposed, the engineer's estimate for the total works being £70,000. The hearing of the Bill was postponed until March 2nd.

Fife Electric Power Bill.—Under this Bill it is proposed to incorporate an electric power company for the whole of the county of Fife. The capital proposed is £600,000 in £10 shares, with power to divide them into preferred and deferred half shares. It is proposed to raise £200,000 by the issue of debenture stock. The first directors are Robert Russell, James A. Hood, W. S. B. McLaren, Henry Graham Harris and three others. The dividends payable are fixed at 8 per cent., subject to a sliding scale based on a standard price of 2½d. per unit, which, with all other prices chargeable by the company, is to be subject to revision every 10 years by the Board of Trade.—The Examiner reported that Standing Orders had been complied with.

Aberdeen Corporation Tramways.—Standing Orders were found to have been complied with in the case of this Bill, which empowers the Aberdeen Corporation to construct additional tramways at an estimated cost of £40,629.

Glasgow Corporation Tramways.—This Bill gives the Corporation power to construct new tramways, and to acquire certain tramways at an estimated cost of £44,093. The Bill also provides for tramways within the burgh of Clydebank.—The Standing Orders were complied with.

Hamilton, Motherwell and Wishaw Tramways.—This is a Bill for conferring further powers upon the company with respect to the construction of tramways, the supply of electrical energy and for changing the name of the company. About 17 miles of new tramways are proposed in the Bill. Part 3 of the Bill provides that the company may supply electricity for power purposes to the following districts:—The burghs of Hamilton, Motherwell and Wishaw, and the parishes of Blantyre, Cambuslang, Hamilton, Dalscif, Bothwell, Dalziel and Cambusmeathan in the county of Lanark. Power is also given to raise £240,000 additional capital.—The consideration of the Bill was postponed.

The New Russian and Austrian Tariffs.—We give below a few extracts from the new tariff proposals which have been elaborated by the Russian and Austrian Governments respectively. The figures in regard to Russia are given in roubles at per pood (36 lbs.), and relate to imports by sea, and, in addition to these, a differential tariff is projected for imports over the western frontier, that is to say, from Germany. This land tariff is about 20 per cent. higher than that for imports by way of the sea, and is not reproduced, as not affecting the trade of the United Kingdom. The Austrian tariff, which is given in kronen (1 krone = 10·2d.) is for weights of 100 kilogrammes or 2 cwts.

The Russian Scheme.

Articles.	New tariff in roubles per pood.	Present treaty tariff in roubles per pood.
Copper wire	7·35 to 11·85	4
Electric cables of all kinds	6·70	2 to 6
Dynamo-electric machines of all kinds and transformers	8·50	1·40
Incandescent electric lamps with holders	30	—
Incandescent electric lamps without holders	60	—
Measuring instruments, including ammeters, wattmeters and voltmeters	15	—
Telephone and telegraph apparatus	12	—
Insulated conductors	12	—
Tramcars (small)	375 per axle	—
„ (large)	510 „	—

The Austrian Project.

Articles.	New tariff in kronen per double cwt.	Present duties in kronen per double cwt.
Copper wire	72	71·43
Dynamos	43 to 72	11·90 to 28·57
Electric lamps	200	119·05
„ apparatus	120	119·05
Cables	48 to 145	42·86 to 89·33

It is estimated that the new Austrian tariff will prejudicially affect the German export trade, as it will close the door to the importation of Teutonic productions, and it may be the means of creating a large home industry which would become a serious competitor to Germany.

Electrical Traction Instruction.—In view of the adoption of electrical power as a means of traction on the South London tramways, the rapidly increasing use of electrically-driven vehicles, and the probable development of electrical light railways being likely to create a large demand among engineers and artizans in the district for a knowledge of electrical traction work, the governing body of the Battersea Polytechnic is arranging a special scheme of instruction with a view to establishing a school of electric traction in connection with the electrical engineering department of the Polytechnic. The Technical Education Board has made a first grant for equipment, and it is hoped within the course of the next year to provide examples of apparatus and machines required for adequate practical instruction so as to fully meet the requirements of students preparing for or engaged in any branch of electrical traction work.

Trade Announcement.—The Westminster Electrical Testing Laboratories have been removed from 14, Great Smith Street, S.W., to larger premises at York Mansions, York Street, Westminster.

Witton Works.—In our article last week on the new works of the General Electric Co., Ltd, we referred to the system of heating and ventilation which had been provided. This was designed, and the apparatus was supplied, by Messrs. Erith's Engineering Co., of 70, Gracechurch Street, E.C., who are specialists in this class of work. The air to be used in the workshops is propelled by fans through radiators heated by steam, the whole plant being concentrated at one spot outside the main buildings; so that the temperature and volume of the air can be regulated at pleasure, with the minimum of piping and labour and of wasted heat.

Cox-Walkers.—About two years ago Messrs. Cox-Walkers, of Darlington, doubled the size of their works, and now, in consequence of increasing business in switchboard, tell-tale and installation work, they find it necessary to again extend. The site they require for this extension is Corporation property, but so far, by a majority of one, the Corporation has declined to allow them to have it. It is suggested that, unless the Corporation give way, the firm will have to remove from the town.

Another New Portable Photometer.—Although we claim that electrical measurements are susceptible of a higher degree of accuracy than any other class of measurements, we are bound to admit that the determination of the candle-power of electric lamps remains a difficult and laborious process, which can only be carried out with precision with the aid of elaborate and expensive apparatus and high technical skill. Messrs. Everett, Edgcumbe & Co. some six months ago made a noteworthy attempt to remove this reproach by putting on the market a very simple apparatus, which was described in our columns at the time, and met with a very favourable reception; but this suffered from the disadvantage that it could only be used in a dark room, and the calculation of the results was somewhat complicated and tedious. The experience gained with this set has led to the introduction of the ingenious portable photometer shown in fig. 1. The method of using the apparatus is extremely simple, and closely resembles that advocated by Dr. Fleming in his classic paper on "Photometry." The standard lamp, B, which forms part of the

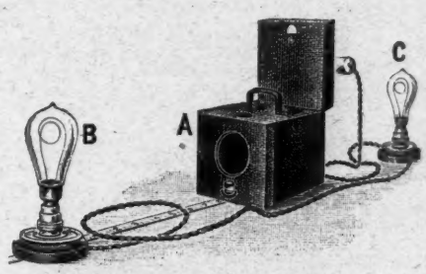


Fig. 1.

set, is placed at a point on the graduated tape corresponding to its candle-power. Another lamp, C, is then shifted backwards and forwards until the photometer spot, when viewed through the small hole at the top of the box, just disappears. The lamp B is then removed and replaced by the lamp to be tested, which is in its turn moved up and down the tape until balance is again obtained. The reading on the scale under the lamp when in this position is the candle-power which is to be determined. As the lamps B and C are connected in parallel, and therefore are both worked at the same voltage, and as, moreover, it has been repeatedly shown that the candle-power of glow lamps depends in a definite way on the voltage, the candle-power of each will increase or decrease in the same proportion for a given change in the voltage. A little consideration will therefore show that the candle-power read off on the scale is that which the lamp would give at the voltage for which the standard lamp is marked, and which is, of course, the candle-power required. Thus, no regulating resistance

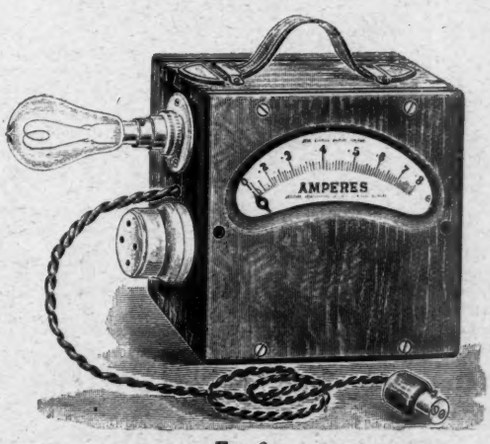
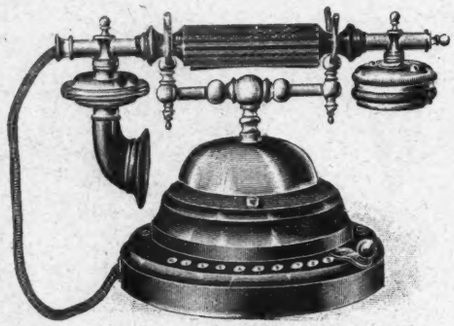


Fig. 2.

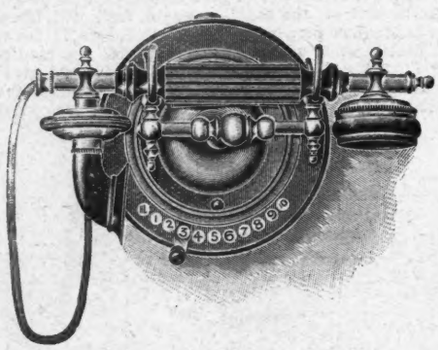
or voltmeter is required for the test. Owing to the fact that the standard is only in use for a few minutes at a time, it can be relied upon to retain its original candle-power for an indefinite period. The photometer can be used in an ordinary room without any special precautions being taken to exclude stray light. This is owing to the special method employed in the test, which, as will be gathered from the description just given, amounts to a kind of double weighing, so that the effect of any external light is automatically compensated for when balancing the comparison lamp C. Instructions are also given for using the apparatus for the measurement of arc lamps and Nernst lamps, and for comparing incandescent gas lamps with electric lamps. To measure the current consumed is not such a difficult matter; for this purpose a handy "Lamp Tester" is manufactured by Messrs. Everett, Edgcumbe & Co., a description of which appeared in our columns some time ago, and which is illustrated in its latest form in fig. 2. Since it was first introduced, the instrument has undergone con-

siderable improvement. The makers claim that it is absolutely dead-beat, which is a most important feature when economy of time is an object, and that it can be used with equal accuracy for either direct or alternating current. The instrument is, moreover, protected from damage, say, through inserting a faulty lamp, by means of a replaceable fuse.

Convertible Telephones.—We illustrate below the "Ceebee" convertible intercommunication telephones, which are made by the Electric and Ordnance Accessories Co., Ltd., of Birmingham. The instruments are convertible, and may be used either as wall sets or table sets. This convertibility is achieved by arranging the cradle to swing round, and it can be set at any desired angle. This is protected by one of the company's patents (No. 8,111/00, by B. Brander). In order to convert from wall to table set, or *vice versâ*, one has only to slacken a screw and turn the cradle to the desired position and finally tighten the screw. No exchange or addition of parts is necessary. The illustrations show



the two positions of this instrument, which is constructed and adapted specially for use with the company's common battery intercommunication system. Another interesting feature of this instrument is the hand set. It has no wire connections on the outside, all being made within the handle. To connect up the receiver and transmitter, it is only necessary to screw them into their respective sockets. The advantage to be derived from this method is obvious.



Should anything go wrong with the receiver, necessitating repair, it is a simple matter for anyone to unscrew this and replace it by a spare one. The line selector may be left in any position without interfering with the signals, and the appearance of the complete instrument suggests neatness combined with high efficiency. Further particulars of this and other telephones (both convertible and fixed) and accessories are given in the recently issued section "B" of the company's catalogue.

Books Received.—"The Engineer's Year-Book," by H. R. Kempe. London: Crosby Lockwood & Son. 1903. 8s.

"Directory and Statistics of Electric Lighting and Traction Works, 1903," edited by C. S. Vesey Brown. London: Hazell, Watson & Viney, Ltd. 6s. net.

"Science Abstracts," January 26th, 1903, and Index to Vol. V., 1902. London: The Feilden Publishing Co., Ltd. 1s. 6d. and 2s. net respectively.

"Medical Electrology and Radiology." January, 1903 (No. 1 New Series). Edited by Dr. W. S. Hedley. London: John Ball, Sons & Danielson, Ltd.

"Elektrische Strassenbahnen," by Johannes Zacharias. Vienna: A. Hartleben. 1903. 4 marks.

Belliss Engines.—The Midland Electric Light and Power Co., Ltd., of Leamington Spa, has ordered from Messrs. Belliss and Morcom a 355-H.P. engine for direct coupling to a continuous-current dynamo. The Electric Construction Co., Ltd., is supplying to the Oxford Electric Light and Power Co., Ltd., one 430-H.P. engine for direct coupling to E.C.C. dynamo, and here also a Belliss & Morcom engine will be supplied. For the Isle of Man Tramways two 430-H.P. Belliss-Witting sets have been ordered.

Catalogues and Lists.—Messrs. E. G. Herbert, Ltd., of Cornbrook Park Works, Manchester, are introducing an automatic circular sawing machine, and they have issued a descriptive sheet relating thereto. It is for cutting up brass and copper tubes, bars and sections, and is a labour-saving machine which is claimed to mark a considerable advance over old methods of cutting up large quantities of these materials.

A small illustrated and priced pamphlet of multipolar dynamos and motors is to hand from Messrs. Flather & Co., Ltd, of Leeds.

Of the many clever devices that we have seen issued in the way of advertisement souvenirs, the little slide rule that we have received from the Reason Manufacturing Co, Ltd., of Brighton, is certainly one of the best. The rule is 5 in. long, and is practically identical as regards the divisions with one-half of the ordinary 10-in. rule, but the scales are ingeniously arranged on a novel plan, which enhances their convenience and utility; the degree of accuracy attainable is about the same as with the upper scales of the 10-in. rule. The Reason Co. are to be congratulated on their capital idea.

List No. 2, received from the Cowburn Safety Valve Co., of Manchester, deals with their dead-weight safety valves.

Mr. A. P. Lundberg, of Liverpool Road, N., has sent us a number of advance illustrated sheets of his well-known switches, plugs and wall fittings.

The Perfecta Seamless Steel Tube Co., Ltd., of Birmingham, have issued a catalogue of their steel conduits and accessories for electric wiring for lighting, bell, and telephone work. The diameters, gauge, reference number, and price per 100 ft. run are clearly stated in table form.

The B.T.H. Co. have issued No. 138 of their excellent set of illustrated pamphlets. It particularises various small switches.

A new revised catalogue of trolley line insulators, including all overhead material, ears, frogs, crossings, &c., supplied by Messrs. R. W. Blackwell & Co., Ltd., has just been issued by the firm.

Dissolutions and Liquidations.—Messrs. P. S. Doherty and E. E. Donat (Doherty & Donat, engineers, Spring Gardens, Manchester) have dissolved partnership. Mr. Donat will carry on the business as Donat & Co., and will attend to the debts of the old firm.

A meeting of the Sussmann Electric Miners' Lamp Co. will be held at 10, Walbrook, E.C., on March 20th to hear an account of the winding-up from Mr. R. Warner, liquidator.

Messrs. W. A. Barrett and E. T. Price (R. C. Cutting & Co., electrical engineers and lightning conductor manufacturers, Wardrobe Place, Doctor's Commons) have dissolved partnership. Mr. Price attends to debts.

A petition presented by Messrs. Chauvin & Arnoux, of Paris, for winding-up H. M. Salmony & Co., Ltd., is to be heard in London on February 24th.

On the same day a similar petition respecting the British Electric Street Railway Co. will be heard.

Willans Engines.—Messrs. Dick, Kerr & Co. have sublet the exciter engines for the power house for supplying the Liverpool to Southport Railway with electrical energy, to Messrs. Willans & Robinson, Ltd. The Central Electric Co. has decided to instal another 3,000 H.P. Willans engine for direct coupling to an Oerlikon alternator. The Chelsea E.S. Co. has placed an order with Willans & Robinson for two 360-H.P. compound engines for direct coupling to dynamos made by the Electric Construction Co.

Nernst Lamps v. Carbon.—According to a report by the librarian of the Gloucester Library Committee, the substitution of Nernst lamps, supplied by the Electrical Co., Ltd., of 122, Charing Cross Road, W.C., for carbon lamps, has resulted in a saving of £6 18s. 7d. for the December quarter, though the Nernst lamps had only been in use for two months. The average consumption of energy per lamp for the quarter was 18 units, as against 24½ in 1901. One of the lamps, tested at the electricity works, after 334 hours' use was giving 37 C.P. (2 more than the nominal), and was more than twice as efficient as a number of carbon lamps tested at the same time.

New Trolley Wire Splicing Sleeve.—We have received a sample of the Acme patent trolley wire splicing sleeve from the inventor, Mr. R. Humphries, engineer and manager to the Isle of Thanet Electric Tramways. It is a simple device, and should facilitate the temporary repair of the trolley wire during busy traffic. The screwed nipple for uniting the sleeves—having to withstand all the working strain of the trolley wire—might with advantage be twice as long as in our sample. In the event of this sleeve being permanently used, some means must be provided for efficiently soldering up the internal joints of the sleeve.

New Cut-out and Joint Box.—We have received from Mr. R. Falshaw, electrical engineer, of Harrogate, samples of Wilkinson's patent house cut-out and joint boxes for concentric mains. It is claimed for the cut-out box that it is reliable, efficient, simple, and compact, and of small first cost. On the other hand, the "Thackray washer" method of holding the porcelain and iron washers in their respective positions cannot compare with the screw in reliability and ease of adjustment; also the numerous rough joints between the washers present a possible field for the diffusion of considerable energy in practical work. It is also possible that the fuses may be too near together, and to the sides of the box; and the present method of attaching the lid to the box could undoubtedly be greatly improved.

The joint box is claimed to be so simple in design that the jointing can be safely performed by any average workman, no

jointer being necessary. It is said to require less time in jointing and to offer exceptional facilities for the examination of the joints before running in the compound, in addition to which it is claimed to be cheaply manufactured. We are somewhat sceptical as to the wisdom of incurring possible bad joints, as against a small additional cost in labour—if, indeed, the average workman would accept less wages than a qualified jointer, after he had learnt his work. Turning to the design of the box, we cannot help thinking that reliable mechanical design has been unduly sacrificed to cheapness. Joint boxes frequently receive very rough usage, and the galvanised iron-wire method of securing the outer case is not as reliable as bolts and nuts. The internal arrangement of the joint does not appear to offer any great advantage over several present methods, and we are afraid the examination of the joints when made, through the apertures provided, would not be very effective or trustworthy. Mr. Wilkinson is to be congratulated on his attempt to cheapen the cost of much-used electrical accessories, and it is quite possible to remedy their defects without adding appreciably to their present low cost.

ELECTRIC LIGHT AND POWER NOTES.

Ashford (Kent).—The U.D.C. has rescinded the resolution recently passed, to apply to the L.G.B. for a loan of £15,000 for electric light purposes.

Barnsley.—The T.C. has applied to the L.G.B. for a loan of £6,438, to cover £3,938 overspent on the electricity works and to provide for further extensions of the plant and buildings.

Belfast.—The Electric Committee has recommended the reduction of the rate for electric lighting to 6d. per unit for the first hour and 1½d. per unit afterwards. It has been further resolved to charge householders a "flat rate" of 4d. per unit.

Bexhill-on-Sea.—The T.C. has received from the L.G.B. sanction to borrow £15,971 for E.L. purposes, the Board deducting from the sum applied for £29, of which £9 was for the provision of glow lamps.

Bombay.—The Corporation has decided to seal an agreement with the Brush Electrical Engineering Co. for the installation of electric light in the city.

Brighton.—The authorities for Portslade, Southwick and Shoreham, whose districts Brighton seeks power to supply with electricity, find it extremely difficult to get the Corporation to arrange terms. So far they have not succeeded, and under these circumstances they recently decided to oppose the Corporation's Bill. A Committee of members of the respective Councils has been trying to effect a settlement, but without success. The representatives of Brighton not only refused to state definite terms, but also declined to give them an assurance that, in the event of the various Councils dissenting and seeking to obtain a supply elsewhere, they would drop them out of the Bill, and so save them the expense of opposing.

Burslem.—The T.C. has decided to appoint an expert to advise the E.L. Committee with regard to a scheme of electric lighting. The Potteries Electric Traction Co. has offered to supply energy on the following terms:—For a minimum supply of 100,000 units per annum, 1½d. per unit for the first 150,000 units, 1¼d. per unit for a further supply up to 300,000 units, and 1d. per unit beyond, up to 500,000. The offer is regarded as a favourable one.

Chatham.—The Assessment Committee of the Medway Board of Guardians has increased the assessment of the Chatham Electric Lighting Co.'s works from £500 gross and £400 net, to £2,902 and £1,066 respectively.

Chadderton.—The Provincial Electric Supply and Traction Co. has announced that it does not intend to proceed with its application for a prov. order for electric lighting.

Clacton.—The ratepayers have asked the T.C. to defer the E.L. question for two years, and to request the B. of T. not to suspend the prov. order for that period. This is a delightfully cool suggestion.

Clacton-on-Sea.—A L.G.B. inquiry into the application of the T.C. for a loan of £15,225 for E.L. purposes was held on February 12th. There was some opposition.

Cults.—Since the electric lighting station was acquired last year by Messrs. Lowdon Bros. & Co., important improvements have been effected. During last summer two pairs of feeder cables were laid, with pilot wires, and various extensions of the mains were made. At the station a new switchboard, made in the company's works in Dundee, was installed. Two of the old engines and dynamos have been removed to make room for a more powerful set, which is to be installed during the spring. The boiler shed has been remodelled, and a new Cornish boiler has been built in.

Dartmouth.—The whole town is now lighted by electricity, the street lamps comprising 10 arcs with 20 incandescents, and 140 incandescents. The Urban Electric Supply Co., Ltd., is the supplier.

Deal.—The T.C. has consented to the application of the Kent Electric Power Syndicate for a prov. order for supplying electricity to the town.

Dumfries.—By a majority of 5 to 4 the Electric Light Committee of the Dumfries Town Council has agreed to recommend the Council not to entertain any offers from a company, but to carry out its own undertaking. The three offers received by the Council were submitted by Edmundson's Electricity Corporation, Messrs. Crompton & Co., and Messrs. J. and J. S. Enright.

Hartlepool.—The T.C. last week sealed an agreement with the Northern Counties Electricity Supply Co. for the supply of electricity for lighting and other purposes.

It was decided, at the same meeting, to ask the B. of T. to further extend the time for carrying out the works authorised under the E.L. Order of 1898.

Hebburn.—The U.D.C. on February 11th decided to erect 10 electric arc lamps in the town for public lighting.

Hertford.—The T.C. on February 11th decided to accept the offer of the North Metropolitan Electrical Power Distribution Co., Ltd., to light the streets with 10 arc lamps, at £14 10s. each per annum, providing a discount of 5s. per lamp for three years is allowed.

Honley.—The U.D.C. has received from the L.G.B. sanction to raise a loan of £4,800 for E.L. purposes.

Huddersfield.—The statement of revenue for the 12 months ended December 31st last shows that there was a balance of income over expenditure of £2,945 12s. 1d. The total income amounted to £23,159 15s. 1d., against £20,574 6s. 6d. in the previous year. Of this amount £21,347 3s. 7d. was for electricity supply, £1,490 2s. 10d. for hire of meters, £210 10s. for hire of motors, and £111 18s. 8d. for fittings service. The working expenditure totalled £10,404 (against £9,722 16s. 2d. in 1901), showing a gross profit of £12,755 9s. 1d. The latter sum was divided up as follows:—£5,008 6s. 10d. interest on loans, £3,492 9s. 11d. contribution towards redemption of debt, £1,309 0s. 3d. amount repaid to the Public Works Board, and £2,945 12s. 1d. net balance surplus, which has been transferred to the depreciation and contingencies account, bringing that fund up to £8,455 2s. 4d.

Ipswich.—The Dock Commission has decided to utilise electricity from the Corporation mains for lighting and power purposes at the docks.

Italy.—A recent report of H.M. Embassy at Rome states that the non-existence of coal in Italy has of late caused keen attention to be paid to the motive power contained in the numerous waterfalls in the country, which has been estimated at 10,000,000 H.P. For many years the waterfalls have been utilised for providing electric light, often over long distances, and for propelling tramcars. Several short electric railways are now in operation which have given satisfactory results, and there is a proposal to connect the capital with Naples by means of a short and fast line of electric traction. The inauguration of the Vizzola-Ticino Electric Supply Co. took place in 1901; it is capable of producing 23,000 H.P., which is intended to be utilised by the manufacturing districts in the neighbourhood of Milan. Many other electric supply companies of lesser importance have been or are in course of being established, with the object of supplying motive power to various industries.

Kidwelly.—The D.C. has decided to provide an electric plant of its own, and will oppose any action taken by the County Electric Traction Co. in this respect. An electrical engineer is to be engaged to prepare a scheme.

Lichfield.—The B. of T. have informed the Corporation that they have no power to extend the prov. order, but that if the compulsory works are not completed by July 3rd next, they will consider the question of deferring the revocation of the order, on the Council giving the Board an undertaking to carry out its obligations. The Council has decided to engage an expert to report on the prospects of electric lighting in the city.

Lowestoft.—At a meeting of the T.C. it was stated that the receipts for the half-year from the sale of electric energy had exceeded the most sanguine expectations by about £640, of which £152 was actual profit. There are 327 consumers, and 17,379 8-C.P. lamps connected.

Lynton.—An error unfortunately occurred in our note under this heading last week; the Electric Lighting Co. has a five years' contract to maintain the public lighting, with 80 glow lamps and one arc lamp. The U.D.C. merely inquired whether the company would be willing to replace the arc by an equivalent number of glow lamps, and has no intention of commencing electricity supply on its own behalf.

Margam.—The D.C. has received from Miss Talbot, a millionaire landowner, the offer of a site for the electric light works and future extensions, covering over 208,000 yds., at the nominal rental of £30 per annum.

Musselburgh.—In view of what is stated as a "technical" difficulty having arisen in the negotiations between the promoters of the Musselburgh electric lighting and tramway scheme and the company to which it desired to transfer its powers, the T.C. has consented to the granting of a new order by the B. of T. in the event of its becoming necessary to drop the present order. The consent of the Council is given with the provision that the conditions under the present order hold good.

Newport.—The Electricity Committee has approved a proposal of the electrical engineer to change the supply of current in the lower portion of the town from alternating to continuous, utilising the existing mains. Mr. Bishop further made suggestions as to re-arranging the hours of work in the departments under his supervision, so as to avoid excessive overtime, and proposed a standard minimum and maximum rate of wages. The Committee has adopted the suggestions.

The Waterworks Committee has decided to charge the Electricity Committee 3d. per 1,000 gallons for the water used at the new generating station.

Peterborough.—The Corporation has given notice for the discontinuation of gas for a number of the street lamps, which are to be replaced by the electric light.

Portsmouth.—The E.L. Committee has recommended the T.C. to reduce the price of energy for motive purposes to the uniform rate of 1½d. per unit, and meter rents in small houses from 10s. per year to 1s. per quarter.

Pudsey.—On Monday the T.C. decided to expend £7,000 on the proposed E.L. works instead of £5,000. It has been ascertained that no extension of the prov. order will be granted, and the Board of Trade will only delay revoking the order for a short time.

Rattray.—The T.C. has decided to defer the consideration of the introduction of the electric light until the intentions of the Blairgowrie T.C. are known.

Rugby.—The U.D.C. has received from the Local Government Board sanction to borrow £12,000 for electric lighting purposes.

St. Albans.—The T.C. is negotiating with the North Metropolitan Electrical Power Distribution Co., Ltd., for the transfer of the Corporation's electric light prov. order.

Sandgate.—The U.D.C. has decided to have the streets lit by electricity, supplied by the Folkestone Electric Light Co.

Spain.—A company has just been formed in Madrid, with a capital of £160,000 and the title La Compania Hidro-Electrica del Salto de Villora, to put down a 9,000-H.P. plant to utilise available water-power in the generation of electrical energy, and to transmit the same to the town of Turia for lighting and power purposes.

Stafford.—The T.C. has decided to oppose the Bill promoted by the North-Western Electricity and Power Gas Co., as there appears no probability of the borough being omitted from the area of supply comprised in the Bill.

Taunton.—The B. of T. has appointed Mr. W. R. Kelsey, B.Sc., principal of the Taunton Municipal Technical Institute, as electrical inspector for the borough. The E.L. Committee has had some difficulty through the flooding of junction boxes, which interrupted the supply of electricity in two or three cases.

Teddington.—The Electricity Committee has recommended the U.D.C. to accept the amended tender of Edmundson's Electricity Corporation, Ltd., for leasing the Council's prov. order.

Tiverton.—The T.C. was recommended on February 11th by the Lighting Committee to accept the offer of Messrs. Suter & Co., to put down an electric light installation to specifications prepared by Messrs. Enright & Co, and to work the undertaking for three years at their own risk. It was decided to ask Messrs. Suter & Co. to report upon the advisability of utilising the River Exe for motive purposes, in conjunction with gas.

Tynemouth.—At the meeting of the T.C. on February 11th it was decided to petition against the Bill of the Newcastle-upon-Tyne Electric Supply Co.

Whitehaven.—The B. of T. has declined to give the Council power to do private wiring for electric lighting purposes.

Winnipeg (Canada).—The electric works of the Winnipeg General Power Co. on the Winnipeg river, near Lac du Bonnet, are now in course of construction. Electrical power is to be transmitted over about 55 miles to the city. The river will be dammed by a dam 400 ft. long and 20 ft. high, and 10,000 H.P. will be developed and transmitted at the outset. It is anticipated that the works will cost $1,000,000, and will be completed and ready for operation within a year.

ELECTRIC TRACTION NOTES.

Ainsdale.—The Birkdale Tramway Co. has declined to extend the electric tramway from Birkdale to Ainsdale, owing to there being no prospect of any return on an expenditure of £10,000.

Ashton-under-Lyne.—The T.C. on February 11th decided to apply for a loan of £50,000 for the reconstruction and electrification of the horse tramways within the borough.

Dublin.—The project of constructing an electric railway between Dublin and Slane (Co. Meath) is being energetically taken up. The proposed route lies through a rich portion of the Counties Dublin and Meath not touched by the railways; it will be 26½ miles in length, and the estimated cost of construction is set down at about £3,000 per mile. It will carry cattle and farm produce of every description, in addition to passengers. It is the intention of the promoters to utilise the water-power of the River Boyne to generate the electrical energy.

Failsworth.—Considerable headway has been made with the fixing of the overhead wires along the electric tram route in Manchester Road, Failsworth, and with the exception of a short length, the whole of the overhead equipment is complete. When cars run through Failsworth it will be possible to go from Oldham to Manchester by electric tramcar, and negotiations for a through service have been opened.

Germany.—The fire brigade authorities of Nurembourg are at present making some experiments with an electrical fire-service wagon.

Holland.—A concession has been granted by the Dutch Government for the construction of an electric railway between Harlem and Amsterdam.

Hove.—The poll of the town having gone adversely for the Corporation, compelling it to abandon its Bill, the B.E.T. Co. has been making great efforts to obtain the Council's consent for it to lay the lines. So far the B.E.T. Co. has been unsuccessful, and it is to be feared that Hove will have to go without tramway facilities. The company's scheme is to connect Littlehampton, Worthing, Lancing, Shoreham, Southwick, Portslade and through Hove to join on to the Brighton Corporation system, about 16 miles along the coast, and from Shoreham to branch inland about six miles to Steyning.

Huddersfield.—We referred last week to the extension plant inaugurated on 11th inst. at the tramway station. Following the starting of the new engine, a luncheon took place in the Town Hall, when Mr. T. H. Moore presided. In proposing the toast of "The Contractors," the chairman said that the contract for the 60-ft. steel rails was let to Messrs. Bolchow, Vaughan & Co., and within one month a first consignment was delivered at Huddersfield. He did not suppose that this despatch could be excelled even in America, though in that country such a feat would have been more freely advertised. Not a single rail failed to pass the test. Mr. Nuttall had reduced the work of tearing up and replacing the old track with new lines almost to a fine art by his method and system. Mr. Moore said that the 650-KW. direct-coupled generator supplied at the outset by Messrs. Mather & Platt had fully upheld the high reputation of the firm. The boosters had been obtained from Mr. T. W. Broadbent, of Huddersfield, and he hoped the result would be such as would bring about a new industry at Huddersfield. The Tramways Committee gave the first order for cars to the British Electric Car Co., of Trafford Park. The chairman also spoke in laudatory terms of the manner in which the minor contracts had been carried out, and, in conclusion, said that the extras on the whole amounts of contracts of £117,491 19s. 5d. did not reach the sum allowed for contingencies, the actual total amount certified for payment being £116,592 4s. 9d. Mr. Nuttall, Mr. Barbour, Mr. Earle (Mather & Platt), Mr. Baylor (British Electric Car Co.), and Mr. Bertram Thomas (underground cable work) responded to the toast. In responding to the toast of "The Engineer," Mr. K. F. Campbell also complimented the contractors upon the excellence of their work, and in reference to the taking-up and reconstruction of the track, said that Mr. Nuttall completed his task by relaying 1 mile 400 yards of track in a week, which the engineer thought constituted a record.

Councillor Hey (chairman of the Halifax Corporation Tramways Committee), in replying to the toast of the "Visitors," said that at Halifax there were various types of engines, including turbines, but he considered the new engine at Huddersfield the most suitable and most economical type of generator for tramway work.

The borough engineer (Mr. K. F. Campbell) has reported at length to the Committee on the contracts for the electrification of the tramways, which amounted to £189,770, while the actual cost was £188,384. The Committee has resolved to fix the Westinghouse brake to all the tramcars, and that Messrs. Milnes, Voss & Co.'s car top covers be fixed to five cars now on order from the British Electric Car Co. Several of these car top covers are fixed to cars now running in the borough.

Kent.—The County Council has withdrawn its opposition to the electric tramway scheme from Chatham to Maidstone, promoted by the Chatham, Rochester and Maidstone Light Railway Co.

Kilmarnock.—The T.C. again on 11th inst. discussed the question of electric lighting and traction. The Corporation has already obtained an order for lighting, and the E.L. Committee recommended that Messrs. Kennedy & Jenkin be instructed to prepare the necessary Parliamentary plans in connection with the proposed tramway line between Beansburn and Riccarton, and that plans and specifications for the works be got ready at the earliest possible date, so that no time should be lost in accepting offers after the tramway order had been obtained. The report was adopted by a majority.

Lancashire and Yorkshire Railway.—In his speech to the shareholders at Manchester the other day, Sir George Armytage said:—They had their works in connection with the

electrification of the railway between Liverpool and Southport. They would have a central power station at Altcar and three transformer stations at other places. They hoped to have all finished about the end of this year, and had every reason to believe that they would obtain a considerable increase of traffic by the greater facilities they intended to give. The estimated capital expenditure for general purposes during the current half-year, for which sanction was asked, was £447,515, and the directors anticipated that they would spend on new works about £259,965.

London.—Marylebone.—At the meeting of the Legal and Parliamentary Committee of the M.B.C. this week, the town clerk reported that the L.C.C. would not proceed with either the Marble Arch to Cricklewood tramway, or the Tottenham Court Road tramway. With respect to the two Clapham Junction and Marble Arch railway schemes, they could not be proceeded with pending the sitting of the Royal Commission on Tube Railways.

Poplar.—The M.B.C. has decided to oppose the L.C.C.'s proposal to employ the overhead system for electric trams in East London, and to urge the adoption of the conduit system.

Mossley.—On Monday the first stone was taken up here in connection with laying the track for the joint tramway scheme, the ceremony being performed by the Mayor. The system will join Mossley with Stalybridge, Hyde and Dukinfield.

Newport (Mon.).—Mr. H. F. Parshall has reported upon the progress made with the new power station contracts. He states that in the power house all the plant necessary for supplying the tramway load and power load is installed and for the most part connected up, and that he is trying to ensure the opening of the power house on March 1st; the tramways should, he thinks, be running on April 1st.

Nottinghamshire and Derbyshire.—The *Financier* states that the promoters of this tramway scheme have deposited the estimates prepared by their engineer, Mr. Alfred Dickinson, showing the cost of constructing the tramways as set out in the Bill deposited for next session. The aggregate cost of the whole scheme is put down at £408,015, of which sum £360,541 will be spent upon the construction of the proposed 79 miles of tramways. The balance will be spent on road widenings, which are estimated to cost £46,526, and upon land for generating stations, car sheds and depôts, which is estimated to cost £947. The capital of the company is to be £750,000, with the right to borrow a further sum of £250,000.

Stockton.—The assessment of the electric tramways at Stockton-on-Tees has been reduced from £2,900 to £2,400, without recourse to litigation.

Sunderland.—The Tramways Committee has a project in hand for carrying out extensions during the next five years. The routes which are being considered include Fulwell, and one to the east-end of the town (the latter being intended to tap the shipping quarters), which are in the borough, and Ryhope and Silksworth, outside the area. The matter is yet quite indefinite, but the chairman of the committee, the vice-chairman, the electrical engineer and tramways manager have recently been making an inspection.

Sweden.—The first step in the substitution of electricity for steam on the State Railways will be taken on the Christiania—Malmo line, a distance of more than 500 km. It is said that the Government will be able to utilise the greater part of the power at the falls of Trollhetta, while Norway will find sufficient motive power at Kykkelsrud.—*Journal des Transports.*

Worthing.—The result of the poll on the electric tramway question was made known on Monday. In favour of the Corporation promoting its own Bill in opposition to the B.E.T. Co. there were 2,968 votes, and against 1,019, a majority of 1,949 in favour of the Corporation scheme.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephone Festival.—The annual festival in connection with the Glasgow district of the National Telephone Co., Ltd., was held on the evening of 13th inst. in the Grand National Hall, Glasgow. Mr. George Franklin, ex-Lord Mayor of Sheffield, and vice-president of the company, occupied the chair. There was a very large gathering. In the course of his address, the chairman said that a year ago there was no doubt they were face to face with serious difficulties in Glasgow, which were due primarily to the phenomenal growth of the company's business in Glasgow, and, in the second place, to the withholding by the Glasgow authorities of underground privileges, which had been so readily granted by municipalities elsewhere. Thanks to the energy of a conscientious and able staff of workers, these difficulties had been overcome, and to-day the company's position in Glasgow was stronger than ever before. With subscribers numbering 12,000, and calls totalling 34 millions per annum, it was clearly proved that their telephone system was of great service to the business community of the city. In Glasgow they had, however, a curious state of affairs; they had municipal competition. He did not propose to discuss the merits of municipal trading, or the demerits of what was called municipal socialism, but he would say that he had always been an admirer of the public spirit and enterprise shown by the Corporation of Glasgow, and because it had chosen to take up the telephone business was no reason, he held, why it should be denounced. He thought, however, that it was a mistake, and had only resulted in so many thousand persons paying two subscriptions instead of one, and the pledging of the credit of the ratepayers for the amount of money required for the undertaking. He had been told that Glasgow had received its charter from King Charles the First. That monarch had lost his head, and there was a possibility that the Corporation which had derived its charter from him had done the same. As they were in competition with the municipality of Glasgow, let them see that it was friendly competition; let it be competition in the interest of the telephone service; let them vie with the Corporation in giving the best possible service, and in giving the greater civility and attention to complaints. If they did that, it would be found that there was room in Glasgow for both telephone systems. During the evening a most enjoyable musical programme was provided.

Glasgow Telephones.—On the 13th inst. Mr. A. R. Bennett, general manager of the Corporation telephone department, lectured on the telephone system under his charge. He traced its progress, and stated that the 8,100 instruments now in connection represented an increase of 4,707 lines since February last year.

Italian Telephones.—Telephonic communication is said to have been inaugurated on 15th inst. between Rome, Milan, and Turin.

Newport (Mon.) Telephones.—Arrangements are in progress for forming a company to give an unlimited service for £6 per annum; an exchange will be established as soon as 350 subscribers are enrolled. Mr. C. A. Clarke, of Manchester, has the matter in hand.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1900 ..	..
Dominica-Martinique	May 7, 1902 ..	..
St. Lucia-Martinique	May 7, 1902 ..	..
Guadeloupe-Martinique	May 7, 1902 ..	..
St. Lucia-St. Vincent	Nov. 18, 1902 ..	..
Martinique-Puerto Plata	July 10, 1902 ..	..
Guantanamo-Mole St. Nicholas	Aug. 4, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
Reissi-Issa-Reissi-Yemani	Oct. 22, 1902 ..	..
Cadiz-Teneriff	Nov. 8, 1902 ..	..
St. Jacques-Haiiphong	Jan. 3, 1903 ..	..
Jamaica-Colon	Dec. 31, 1902 ..	..
Sitvebondo-Bandjermasin	Jan. 26, 1903 ..	..
Marseilles-Barcelona	Jan. 28, 1903 ..	..
Landlines:—		
Route to Tientsin and Taku *via* Helampo ..	June 18, 1900 ..	..

Wireless Telegraphy.—The *Daily Chronicle* says that, although the Postmaster-General has not appointed a committee to consider the Marconi system of wireless telegraphy, the Government has sanctioned the formation of an inter-departmental committee to inquire into the matter. The General Post Office, in common with the other Government offices, is merely represented on this committee.

Mr. Marconi had the honour of being received by the King at Buckingham Palace on 13th inst.

CONTRACTS OPEN AND CLOSED.

OPEN.

Austria.—March 10th. Tenders are being invited until March 10th by the Austrian State Railway authorities at Lemberg for the supply and erection of a complete plant for the electric lighting of the railway station at Lemberg. Tenders are to be sent to Die K. and K. Staatseisenbahn Direction, Lemberg, whence particulars may be obtained.

Barking.—March 20th. Overhead equipment, poles, feeder cables, &c. See "Official Notices" February 13th.

Battersea.—March 2nd. Coal, stores, carbons and meters. See "Official Notices" February 13th.

Battersea.—March 10th. One 300—350-kw. steam dynamo, &c. See "Official Notices" to-day.

Bedford.—February 25th. 500-kw. steam alternator. See "Official Notices" February 13th.

Belgium.—March 5th. Tenders are being invited until March 5th by the municipal authorities of Ghent, for the concession for the electric lighting of the town. Tenders are to be sent to L'Hotel de Vil'e, Ghent, whence particulars may be obtained.

Bermondsey.—March 2nd. Carbons, electricity meters, indicators, fuses, oil, incandescent lamps, cables, stores, &c., for 12 months. See "Official Notices" February 13th.

Bexhill.—February 21st. 300-kw. steam dynamo, water-tube boiler, superheater and crane. See "Official Notices" February 6th.

Bilston.—March 16th. Wiring and fittings for public buildings. See "Official Notices" to-day.

Buenos Ayres.—The Municipality of Juarez, Province of Buenos Ayres, is calling for tenders for the public lighting of that town.

A River Plate contemporary says the Council intends calling for tenders for constructing and working an electric tramway to the west of the city, to the suburbs of Ortuzar, Mazzini, Modelo and Urquiza.

Bulawayo. — February 26th. Establishment and working of an electric tramway. See "Official Notices" Nov. 21st.

Burnley. — February 23rd. Cables for lighting and tramway extensions. See "Official Notices" February 6th.

Bury.—February 27th. Tramway poles, overhead line, section boxes, &c. See "Official Notices" February 13th.

Bury. — March 6th. Traction switchboard and accessories. See "Official Notices" to-day.

Cardiff.—February 24th. Five Lancashire boilers, &c. See "Official Notices" to-day.

Chester.—February 28th. 150 electricity meters. See "Official Notices" February 13th.

France.—March 5th. The French Post and Telegraph authorities in Paris are inviting tenders until March 5th for the supply of 110 tons of bronze wire, and 1,500 tons of copper wire. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle 103, Paris.

Glasgow, &c.—The May-Oatway Fire Appliances, Ltd., is inviting tenders for wiring for fire alarm installations in Glasgow and other towns. See advertisement pages to-day.

Holyhead.—March 4th. A complete electric lighting plant for the U.D.C. See "Official Notices" to-day.

Italy.—February 23rd. Tenders are being invited until the 23rd inst. by the Italian Naval Authorities at Spezia for the supply of a large quantity of electric lamps and lampholders.

Kingston-upon-Hull.—February 26th. Two Lancashire boilers, coal conveyor, stokers, &c., and fuel economiser. See "Official Notices" February 6th.

Koloszvar (Austro-Hungary). — March 10th. The Municipal authorities of Koloszvar, Austro-Hungary, are prepared to consider tenders for the installation of an electric power station for the supply of motive power. Estimates are to be based on carrying out the enterprise at the expense and risk either of the town or of the would-be concessionnaires, and should be addressed to the municipality in question, at Matyaskiraly, No. 1, I. 5, Koloszvar.

London County Council.—March 17th. 200 tramcars, complete with trucks, motors, controllers, &c. (100 bogie and 100 single truck). See "Official Notices" to-day.

Manchester.—March 5th. The Electricity Committee wants tenders for wiring nine sub-stations.

Merthyr Tydfil.—February 25th. Hill's Plymouth Co., Ltd., invites tenders for the supply of electrical appliances. Forms of tender to be obtained at the company's offices at Merthyr.

Metropolitan Asylums.—February 25th. The M.A. Board wants tenders for electric fire alarm installations at Eastern and Western Hospitals. See "Official Notices" February 13th.

Oldham.—February 24th. The Electricity Committee wants tenders for the supply, delivery and erection of cooling towers, motor-driven centrifugal pumps, motors, and switchgear, pipework and overhead travelling crane, comprised in specification No. 10.

Portsmouth.—March 6th. Lancashire boilers, steel chimney, fan and engine for induced draught, piping, &c See "Official Notices" to-day.

Rathmines.—February 24th. Coal, electricity meters, carbons, stores, &c., for 12 months. See "Official Notices" February 13th.

Rosario.—March 16th. A River Plate exchange says that the two tenders received by the Municipality for the lighting of the city by gas or electricity not having been accepted, new tenders are being called for, which will be received up to March 16th, 1903.

St. Annes-on-Sea. — March 4th. Cables and extensions to induced draught plant. See "Official Notices" to-day.

Stockport.—February 28th. The Tramways Committee invites tenders for laying permanent way of the electric tramways.

Sunderland. — February 27th. Surface condenser, induced draught fan, battery and booster, and piping. See "Official Notices" February 6th.

Wakefield.—March 2nd. Feeders and conduit. See "Official Notices" to-day.

Warrington.—March 4th. Water-tube boilers and pipework, two 750-KW. steam dynamos, switchboard extensions. See "Official Notices" February 6th.

Wimbledon.—February 25th. H.T. switchboard and gallery. See "Official Notices" February 13th.

CLOSED.

Bermondsey.—The Borough Council on Tuesday placed a contract for lamps and columns, also switch pillars, &c., with Messrs. Crompton & Co., at £1,454. The other tenderers were Oliver & Co., £1,360; W. Lucy & Co., £1,375; Gilbert Arc Lamp Co., Ltd., £1,409; Brockie-Pell Arc Lamp, Ltd., 1,429; Johnson and Phillips, £1,434; Improved Electric Glow Lamp Co., Ltd, £1,443; British Prism Globe Electrical Co., Ltd., £1,495; Drake & Gorham, Ltd., £1,532; General Electric Co. (1900), Ltd., £1,585; British Westinghouse Co., £1,588; New Century Arc Light Co., Ltd, £1,638; Clift Manufacturing Co, £1,666; Veritys, Ltd., £1,712; Richard Woods & Co. (not in order), £675.

Bucks.—The County Council has accepted the tender of Messrs. Lea & Warren, of Kettering, for installing the electric light at the County Asylum at £5,053, and that of Messrs. W. J. Furse and Co., of Nottingham, for an installation of telephones and tell-tales at £340 18s.

Bury St. Edmunds.—The T.C. has accepted the tender of Messrs. J. Fowler & Co., Ltd., for an engine and dynamo at the electricity works; that of Messrs. Cole, Marchant & Morley, Ltd., for condensing plant; and that of Mr. H. G. Frost for a tower and small cooling plant.

Colchester.—The Corporation has just recently accepted the tender of Messrs. Mather & Platt, Ltd., for a 136-KW. dynamo, for direct coupling to a Davey-Paxman engine. This machine, when working compound, will give an output of 550 volts and 650 amperes at a speed of 300 revs., and when working as shunt it will give 460 volts, 800 amperes at the same speed. The specification requires that the machine shall be capable of standing an overload of 10 per cent. for two hours or of 25 per cent. momentarily.

Hebden Bridge.—The extensive dyeing and finishing works situated at Midgehole, and owned by the English Velvet and Cord Dyers' Association, Ltd., is to be fitted throughout with the electric light, all wires and cables being in steel conduits. The tender sent in by Mr. R. S. Blackburn, of Ribstone Works, Hebden Bridge, has been accepted.

India.—The contract for the three-phase switchboards required by the Bengal Nagpur Railway Co. has been placed with Messrs. Kelvin & James White, Ltd.

Ipswich.—The T.C. on February 11th accepted the tender of the British Westinghouse Co., Ltd., for tramcars, with bodies and trucks by the Brush Co., and Westinghouse motors and equipment at £15,149 18s.

London.—The L.C.C. has received the under-mentioned tenders for the laying of the stoneware ducts for the cables required for the New Cross—Greenwich tramways, and other lines:—

Reid Brothers	(Accepted)	£24,363
W. Griffiths & Co.		27,951
S. Kavanagh & Co.		30,442
J. A. Ewart		30,713
J. Smith & Co.		37,034

Newcastle-on-Tyne.—The contract for the full equipment of superheaters, for the Manors power station of the Corporation tramways undertaking, has been awarded to the Cruse Controllable Superheater Co., of Manchester. A trial set of three superheaters fitted some 18 months ago, under the specification of Mr. Chas. Hopkinson, has given great satisfaction.

Natal.—The Natal Government Railway have placed the order for the main and all the distribution boards required in connection with the electrical equipment of their works with Messrs. Kelvin & James White, Ltd.

Radcliffe.—The U.D.C. has just accepted the tender of Messrs. Mather & Platt, Ltd., for the supply of additional plant for the electricity works. It consists of two steam sets each comprising a Browett-Lindley two-crank compound engine, and a Mather and Platt 120-KW. multipolar dynamo. These machines will be wound to give an output of 550 volts and 220 amperes when working compound, and 480 volts and 250 amperes when working shunt, both at a speed of 450 revs. The same company is supplying a jet condenser with an Edwards three-throw pump driven by an electric motor, for dealing with 15,000 lbs. of exhaust steam per hour; also one of its variable stroke electrically-driven pumps for boiler feed.

Shipley.—Messrs. J. G. White & Co., Ltd., have received the contract for the complete construction of the Shipley tramways, including permanent way, overhead, tramcars and equipments, and cables, at £65,000. This is the first section of the Mid-Yorkshire scheme, for which powers are at present being obtained. The total estimated cost amounts to £450,000.

Sunderland.—Last week the T.C. accepted the tender of Messrs. Clayton, Son & Co., for a Lancashire boiler for Hylton Road Station. The Electricity Committee reported that agree-

ments with the North-Eastern Marine Engine Works, Ltd., and Messrs. W. T. Doxford & Sons, Ltd., for the supply of electricity for motor power had been prepared and were presented for sealing. The high-tension trunk cables necessary for this supply will be laid by the Callender Co.—from Hylton Road Station to South Docks, Monkwearmouth, and Pallion sub-stations—at an estimated cost of £13,600. The necessary motor-generators and switchboard for the Pallion sub-station will be obtained on the schedule of the Allgemeine Electrical Co. at a cost of £2,801. The two firms named would require between them about one million units per annum.

Wallasey.—Messrs. Thornton & Crebbin, of Bradford, have received an order for a patent counter current condenser, complete with their standard air and circulating pumps for the power and electric lighting station at Liscard.

Walsall.—In regard to our notice of last week, the cars to be supplied by the Brush Co. are to have B.T.H. equipments, the said equipments consisting of two G.E. 58 four-turn motors, two B. 18 controllers, one B. 2 trolley standards, the usual switches, fuses, circuit breakers, lightning arresters, &c.

Yarmouth.—The Corporation has accepted the tender of Veritys, Ltd., for the supply of carbons at £4 13s. 3½d. per 1,000 pairs, that of Messrs. Babcock & Wilcox, Ltd., for two 250-H.P. boilers and an economiser for the electricity works at £1,731.

Yorkshire.—Tasker's Engineering Co., of Sheffield, have obtained the contract for a three-phase power plant to be installed at the Silkstone Fall Colliery, Yorkshire. The plant includes an electrical coal-cutter, driven by a three-phase motor.

FORTHCOMING EVENTS.

Friday, February 20th.—At 9 p.m. Royal Institution. Mr. E. H. Griffiths on "The Measurement of Energy."

At 3 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Board of Trade Electrical Standards Laboratory.

Saturday, February 21st.—At 7.30 p.m. Glasgow Technical College Scientific Society. Mr. J. Andrews on "Water in Steam."

Tuesday, February 24th.—At 8 p.m. Institution of Civil Engineers. Paper on "Mechanical Handling of Material," by G. F. Zimmer.

Wednesday, February 25th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Section). Meeting in the University Buildings. Paper by Mr. A. M. Taylor on "Network Tests and Station Earthing."

Thursday, February 26th.—At 8 p.m. Institution of Electrical Engineers. "The Nernst Lamp," by J. Stöttner, and, if time permits, "Distribution Losses in Electric Supply Systems," by A. D. Constable and E. Fawssett. Abstract of a paper read before the Glasgow Section on February 10th:—"A Study of the Phenomenon of Resonance in Electric Circuit by the Aid of Oscillograms," by M. B. Field.

Friday, February 27th.—At 3 p.m. Institution of Electrical Engineers (Students' Section). Visit to the Board of Trade Electrical Standards Laboratory.

Saturday, February 28th.—Annual Corps dinner of the Electrical Engineer Volunteers at the Trocadero Restaurant has now been postponed.

NOTES.

Dinner to Sir William White.—A complimentary dinner to Sir William White, K.C.B., F.R.S., the late Chief Constructor and Assistant Controller of the Navy, is being organised by his professional brethren, and will be held, by kind permission of the Wardens of the Worshipful Company of Goldsmiths, at the Goldsmiths' Hall, on Thursday, March 26th. A large and representative Committee has been formed, among whom are:—Mr. Hawkshaw, President of the Institution of Civil Engineers; Mr. Maw, President of the Institution of Mechanical Engineers; the Earl of Glasgow, President of the Institution of Naval Architects; Mr. Whitwell, President of the Iron and Steel Institute; Mr. Swinburne, President of the Institution of Electrical Engineers; the Earl of Northbrook; Lord Kelvin; Lord Brassey; Lord George Hamilton; Sir Frederick Bramwell, Bart.; Sir Bernard Samuelson, Bart.; Sir James Kitson, Bart.; Sir Lothian Bell, Bart.; Sir Edward Carbutt, Bart.; Admiral Sir John Hay; Sir John Wolfe Barry; Sir William Preece; Sir Benjamin Baker; Sir Nathaniel Barnaby; Sir George Bruce; Sir John Durston; and Sir J. I. Thornycroft. Sir Frederick Bramwell, Bart., is the hon. treasurer, and Mr. Leslie S. Robertson, M.Inst.C.E., 28, Victoria Street, Westminster, the hon. secretary.

Junior Institution of Engineers.—On Saturday last the 18th anniversary dinner of this society took place at the Hotel Cecil. The guests were received by the President, Col. Edward Raban, C.B., R.E., Director of Works of the Navy, and the chairman, Mr. Kenneth Gray. Among those present were Sir Evan MacGregor, K.C.B., Secretary to the Admiralty, Sir J. Jackson, Col. R. M. Ruck, R.E., of the War Office, Mr. Fletcher Moulton, M.P., and Messrs. Percy Griffith, W. J. Tennant, Basil P. Ellis, and F. W. Stokes.

After the loyal toasts, Mr. Griffith proposed the "Navy and Army." In reply, Sir E. MacGregor said that, though during his 18 years of office he had seen many great changes, no change had taken place in the spirit of the men. Col. Ruck, replying for the Army, hinted at a gigantic struggle in the future, and pointed out the great difficulty of the task of reorganising an army dispersed throughout an empire. He thought that if the public would show the same interest in the Army as in the Navy, the former would become as efficient as the latter already was, and for the same reason.

Mr. W. J. Tennant toasted the "Senior Institutions," alluding specially to the work of Mr. Aston Webb, President of the R.I.B.A., who replied that while someone had said, "The juniors think the seniors are fools; the seniors *know* the juniors are"—he disputed the truth of the cynicism.

Mr. Moulton, proposing the "Junior Institution of Engineers," likewise quoted the saying of an old Master of Cambridge, "We are none of us infallible—not even the youngest of us," but congratulated the Institution on the youth of its members, and urged them not to let their elders "boss the show." Mr. Moulton reproached British capitalists with timidity, and contrasted them with Americans, referring to the "wonderful results" achieved by the latter.

Mr. Kenneth Gray, in a brief reply, stated that the Institution was in a prosperous condition, and had put aside £300 towards a building fund.

The President then proposed the toast of "Twentieth Century Engineering." He regretted the absence of Mr. Marconi, and referred to various directions in which engineers were at present actively progressing, concluding with the Nile irrigation works.

Mr. Basil Ellis, of Messrs. John Aird & Sons, contractors for the great dam of Assouan, in reply, gave an interesting description of the works; Mr. F. W. Stokes, of Messrs. Ransomes & Rapier, who designed and supplied the sluices, gave an amusing account of his endeavours to find something "semi-humorous" to say about them, in accordance with instructions, and took occasion to point out that consulting engineers' specifications were not necessarily inspired documents.

Mr. Kenneth Gray proposed "The Health of the President," who suitably acknowledged the compliment.

During the proceedings Mr. Sidney Anning gave some amusing sketches, and Mr. T. E. Gatehouse contributed two violin solos; Mr. Kenneth Gray sang with refinement and grace two excellently chosen and musicianly songs, for which we were duly grateful.

Obituary.—The *Times* Berlin correspondent announces the death of Herr Erich Rathenau, director of the Allgemeine Elektricitäts Gesellschaft, which took place at Assuan, in Egypt, on January 19th. The deceased gentleman was the younger member of the well-known family of electrical engineers who are at the head of the management of the Allgemeine Elektricitäts Gesellschaft. Before the funeral, which took place in Berlin on Monday, the coffin was placed in the great machinery hall of the works at Ober Schöneweide, where addresses were delivered by the former Minister of Marine, Admiral Hollmann, and others. The Emperor was represented by his aide-de-camp, Lieutenant-General von Scholl.

Institution of Electrical Engineers.—At the meeting last week the following proposal of the Council was announced by the President:—About Easter in each year, in accordance with the articles of association, the Council prepare a list of members and associate members or associates to fill the several vacancies that there will be on the Council at the ensuing annual general meeting. This list must be read at an ordinary general meeting four weeks or more before the annual general meeting. The Council now invite members to assist them in the preparation of this list by sending to the secretary suggestions of suitable names; all those so sent in will be considered by the Council, who, with this list before them, will select the names of the members, associate members, and associates whom they will in due time nominate in the prescribed way to fill the several vacancies.

British Electrical Superannuation Fund.—The report of the managing trustees for the year ended December 31st, 1902, shows that, since the end of 1901, the net membership of the Fund has increased by nearly 80 per cent.—viz., from 81 to 145; 86 belong to the B.E.T. Co., 29 to associated companies, and 30 to other concerns. Nine new companies, including the City of London Electric Lighting Co., joined the Fund during the year. The net total number of contributing companies, as at December 31st last, stood at 25, and, apart from any further adhesions which may be looked for from companies outside the B.E.T. organisation, the absorption of the E.P.D. group of undertakings by the B.E.T. will probably result in a large increase of the present figure by the end of the year.

Electric Shock Fatality.—The *Review of the River Plate* records that about the middle of January a youth in charge of the switchboard at the Buenos Ayres market was killed as the result of a shock. The current, it is said, was low pressure.

London County Council. — At last week's meeting the Council resolved to lend £20,570 to the Hackney Borough Council for electric lighting purposes, and to sanction the borrowing by the Islington Council of £770 for similar works.

Technical Education.—The Technical Education Board reported that every year witnessed a closer connection between the technical schools and the various industries, and that the students in the polytechnics and technical institutes, aided by the Council, were now meeting with marked success in obtaining situations in leading establishments. As an instance, the board mentioned that numerous successes were recorded in connection with the mechanical engineering and electrical department of the Regent Street Polytechnic, from which over 60 students had recently obtained good appointments through the training which they had received in the technical classes. Among others the following firms were mentioned as having taken directly into their employment students from the Polytechnic. Messrs. Siemens Bros., the Westinghouse Brake Co, the National Telephone Co., Messrs. Thorneycroft, the Thames Iron Works, Yarrow & Co., the Edison & Swan Co., and Vickers, Sons & Maxim. The board added that other polytechnics had achieved equally satisfactory results.

Electric Tramways.—The Council sanctioned an expenditure of £2,530 in connection with the laying of tramway tracks and the provision of electrical equipment, &c., at the temporary car sheds to be erected at the tramway depôts at Balham and Rye Lane.

The Highways Committee reported that the work of reconstructing the Westminster—Tooting tramways was nearly completed, and it was anticipated that in a short time the temporary power station and sub-stations would be in operation. It was probable the lines would be in working order by the end of April, and the Committee proposed that the conversion should be inaugurated by a public ceremony.

An expenditure of £2,700 was approved for laying a double line of track for a short distance in Wandsworth Road and Nine Elms Lane, so that the carriageway, which is about to be widened, would not have to be again disturbed in the event of its being found possible at some future time to obtain the consent of the Borough Councils and the Board of Trade to the adoption of the overhead system of electric traction on that route.

The Joint Parliamentary and Highways Committee submitted a report, reminding the Council of the reference to consider the advisability of the Council promoting in the session of 1903 a Bill on the subject of underground railways in London. It had, however, not been found practicable to do so, but a preliminary report on the subject had been prepared by the officers. It was necessary to provide a complete and satisfactory scheme, and the Committee asked for sanction to expend £500 for the purpose of enabling the officers to more fully report on the question of locomotion.

The Council decided at the meeting on Tuesday last to seal petitions, for presentation if necessary, against the underground railway Bills and tramway Bills of the present session, in order to safeguard the Council's position. A committee was appointed to conduct the County Council's case before the Royal Commission on locomotion and transport in London.

Automobile Batteries.—The French Automobile Club has dropped the proposal to hold a competition of electric batteries this year.

University Notice.—The services of examiners are required for the engineering department of the University of London. Some particulars are given in our advertisement pages to-day.

Electricity in the Navy.—The *Globe* says that the Electrical Committee, which has been sitting on and off for the last year at the Admiralty, has almost completed its labours. Though it is not to be supposed that all their recommendations will be adopted forthwith, yet the importance and progress of electricity in the Navy will at last receive official recognition.

Appointments Vacant.—The Metropolitan Asylums Board require a chief assistant engineer at £300; a resident electrical engineer is required for Sunderland at £200; an assistant engineer for St. Helens at £100; shift engineer at Manchester at £150. See "Official Notices" to-day.

Personal.—A social evening was spent at the Clarendon Rooms, Glasgow, on Monday evening, as a send-off to Mr. R. Percy Sims, who is resigning his present position as manager to Messrs. Lowdon Bros. & Co. in order to take up an important appointment on the staff of a large firm of mechanical, civil, and electric traction engineers. During the course of the evening a very handsome gold-mounted umbrella was presented to Mr. Sims by Mr. Donald Morris, on behalf of the men employed in the Glasgow district.

The Great Western Electrification.—The *Evening Standard* says that the directors of the Great Western Railway Co. have appointed a Committee of their number to investigate the question of the electrification of portions of their system, and that this Committee has called in Prof. Kennedy, the well-known electrical expert, to advise it, in conjuction with Mr. Churchward, who at the beginning of the present year succeeded Mr. Dean as chief mechanical engineer of the company.

Institution of Electrical Engineers (Local Sections).—Before the Glasgow Section last week, Mr. M. B. Field gave a paper on "Electrical Phenomena by the Aid of Oscillograms."

Before the Leeds Local Section on Thursday, 19th inst., Mr. H. Dickinson delivered his inaugural address; a paper was read thereafter by Mr. R. A. Chattock, on "Motive Power Supply from Central Stations."

London Traffic Commission.—The indisposition of Sir David Barbour, the chairman, is responsible for the delay in holding the preliminary meeting of this Commission.

German Competitive Methods.—It is announced in several newspapers that German competitive enterprise is about to take another and an original form:—"A journal devoted to electrical subjects is soon to be printed in Berlin in the English language and circulated wherever the British flag flies, the object being to set forth the superiority of German electricians as opposed to all comers. One of the curious features of the undertaking is that this new Anglo-German industrial publication is to be backed by one of the great German electrical manufacturing companies. An English technical journalist has been secured to edit the new paper."

Electro-Galvanising.—Dr. Carl Richter in the issues of the *Elektrochemische Zeitschrift* for November, December and January, discusses at great length the electro-galvanising industry, and the methods which, in his opinion, ought to be employed in testing articles of galvanised iron. Dr. Richter, we believe, is interested in the introduction of electro-galvanising methods into Germany and Austria, and he believes that the comparative slow progress of this industry is partly due to the absence of reliable and accurate methods for testing the physical and chemical properties of the coating produced. The following are the properties for which Dr. Richter considers tests are required:—

1. *Geometrical and Optical Properties.*—Form, colour, lustre.

2. *Mechanical Properties.*— Hardness, continuity, elasticity, tensile strength, adhesiveness.

3. *Chemical and Electro-Chemical Properties.*—Constitution, resistance to corrosion, protective power.

4. *Thermal Properties.*—Shrinkage and expansion on application of cold and heat.

5. *Properties of the Base-Metal.*—Any alteration in these after coating with zinc should be noted.

The methods of laboratory examination for obtaining comparative results in relation to the above properties are fully discussed, and the author suggests in closing his lengthy article, that the next step is the application of these methods to the practical requirements of the electro-galvanising industry. It is, perhaps, not generally known that the property given in Richter's table under III. c., namely, "protective power," is the origin of the term *galvanised* iron. Zinc and iron form a galvanic couple when exposed to damp air, and even when the zinc coating has been pierced, so long as the superficial area of the exposed iron is not too great, the surrounding layer of zinc protects the iron from oxidation or rusting. The area protected increases with the thickness of the zinc deposit. The hot or dipping method of producing "galvanised" iron (dipping the sheets after special cleaning in molten zinc) is still employed for the greater portion of the output of galvanised sheet iron, and the use of the electrolytic method is confined to a limited group of articles for which it is specially adapted. While admitting that the slow growth of the electro-galvanising industry may be partly due to the causes which Dr. Richter has suggested in his articles, we are inclined to believe that the chief retarding influence has been the fact that the electrolytic process is more troublesome and more expensive than the older "dipping" process. It may be considered open to question whether the improved physical properties of the coating produced compensate fully for this extra trouble and expense, and we shall therefore await Dr. Richter's promised further contributions on this subject with interest.

Hands, Ltd.—On Wednesday Mr. Justice Buckley made a compulsory winding-up order against Hands, Ltd., of London.

THE CENTRAL STATION ENGINEER.

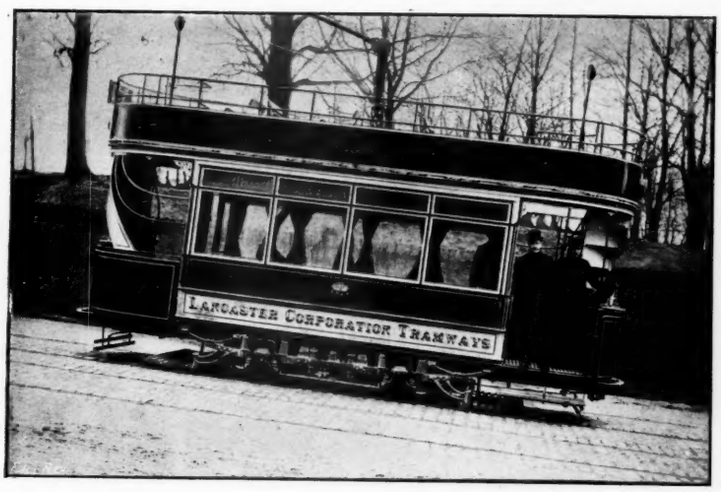
Mr. G. E Sanders, assistant electrical engineer to the Borough of Hampstead, has been appointed chief engineer to the King William's Town Electric Lighting and Cold Storage Co, and left England on Saturday last, to take up his duties there. After leaving the Bedford Grammar School, Mr. Sanders was for seven years at the L. & N.W. Railway works at Crewe, and for about the space of three years in each case, was assistant electrical engineer at Ealing and Bedford Corporation works.

Mr. F. Bruton has resigned the post of assistant engineer at the Ashton-under-Lyne Borough electricity works.

On Tuesday, Mr. W. C. Fripp, who has been appointed assistant electrical engineer to the Government of Malta, was presented with a collection of standard technical works by the staff of the Wallasey Gas, Water and Electricity Departments.

LANCASTER ELECTRIC TRAMWAYS.

Few towns with a history like Lancaster have progressed so rapidly within the last quarter of a century, for by the banks of the Lune commercial and municipal enterprise have been contemporaneous, while as a natural sequence the population has almost trebled. To the "City Fathers" no little credit should be given for their wisdom in seeing that Lancaster, as the capital of the County Palatine, should not lose prestige by sticking to "old ruts."



Car on Gradient of 1 in 10, Bowerham Road.

Parliamentary powers were obtained by the Corporation in its 1900 Act to construct a network of tramways in the borough, at an estimated cost of about £70,000. This figure excluded the sum needed for the purchase of the horse-traction system of the Lancaster and District Tramway Co., which owns a four-mile line to Morecambe, and which, after a little friction, is now negotiating for the sale of its tramway to the Corporations of Morecambe and Lancaster. The first two sections of the scheme have been successfully completed at a cost of about £23,000, exclusive of the cost of the erection and equipment of a new power station rendered necessary thereby.

The work of installation began in March, 1902, and about three miles of tramways have been laid down with a gauge of 4 ft. 8½ in. The routes are from Dalton Square to Scotforth suburbs, and there is a junction at the Pointer, the first ½d. stage to Williamson Park, a popular place of recreation. The line is single, with numerous turn-outs.

In the road construction the excavations generally were 12 in. deep, allowing a 6-in. rail section to be used upon a 6-in. bed of concrete. The rail joints are supported by anchor sole-plates, of 60 lbs. weight, and 24 in. long, inverted and riveted to the bottom of the running rail. The weight of the rails is 90 lbs per yard, and they are 60 ft. long. All the rails and fish-plates were supplied by Messrs. Walter Scott & Co., of the Leeds Steel Works, while the special work at points and crossings was done by Messrs. Askham Bros. & Wilson, of Sheffield. Askham's patent drain boxes have been fixed where necessary, and all the points have also been connected to the drains. Each joint is bonded with two 0000 Crown Chicago bonds.

Tramway in Scotforth Road.

Pole at Pointer Junction.

Gradients are fairly frequent, the steepest being on the Park route, approaching a curve in Bowerham Road, which is 1 in 10, with a radius of 80 ft. There are not, however, many curves. The sharpest on the track already in existence

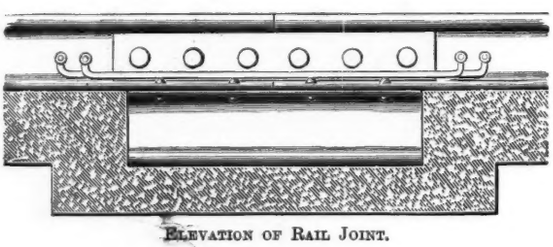
is 60 ft., with the exception of the entrance to the car shed in Dalton Square.

Power is transmitted by the overhead trolley system, side-bracket poles being used throughout, manufactured by the British Mannesmann Tube Co. These poles were planted in concrete, 6 ft. in the ground. The bracket arms are of a light pattern, and are constructed of hydraulic steel tubing and scroll work.

The overhead equipment was erected by Messrs. Lowdon Bros. & Co., of Dundee. The trolley wire is No. 000 hard-drawn copper, and is double throughout. The wires are supported from the bracket arms by flexible suspension, with Ætna insulators. Where necessary, guard wires are provided.

A section feeder box is placed at every half-mile of the track, fitted with marble panels carrying four switch fuses, two feeder switches, lightning arrester, choke coil, and telephone plug connection. The tramway cables are laid in the centre of the track in Sykes's earthenware conduits. The cables are of the Callender vulcanised bitumen type, with Callender watertight draw-in boxes.

A car-shed has been constructed at the terminus in Dalton Square, 187 ft. long × 45 ft. broad, with accommodation for 18 cars; at present 10 have been purchased, of the double-deck type, with reversed stair-cases. They accommodate 42 adult passengers each, 18 inside, and 24 outside, and are 26 ft. long.



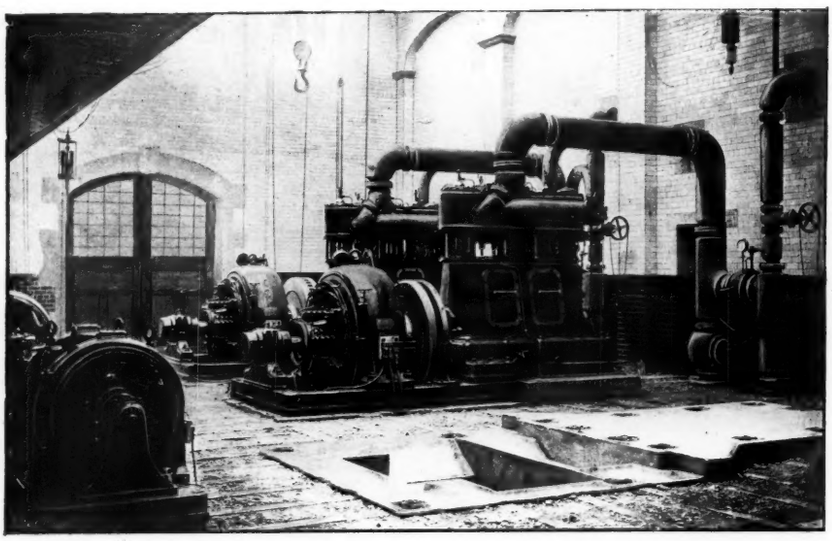
Elevation of Rail Joint.

On the top of the cars Challenger dry seats are fitted. The trolley-mast is of Messrs. Blackwell's enclosed spring type, with swivelling trolley for side running.

The bodies of the cars are mounted on Brill trucks with 6 ft. wheel base, fitted with two No. 46 Westinghouse motors of 25 H.P. each, and Westinghouse series-parallel controllers. Each car is equipped with the Newel magnetic brake for use on the steep gradients. Tidswell life-guards are provided on each car.

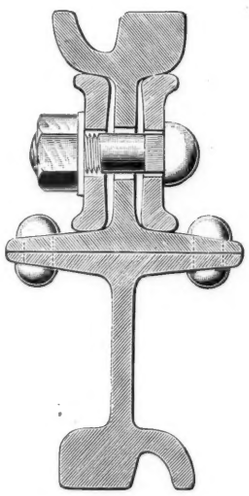
As previously indicated, a new power station has been erected, with an engine room 70 ft. by 38 ft., containing two 200-KW. steam dynamos, two 300-KW. steam dynamos, one motor-generator of 60 KW., and one balancer of 23 KW. The engines are of Messrs. Belliss & Morcom's three-crank compound type. The generators, motor-generator, and balancer are by the British Westinghouse Co., and were constructed at Trafford Park, Manchester—the first turned out by the company at these works. Each set is capable of supporting an overload of 25 per cent.

The main switchboard was also manufactured by the British Westinghouse Co., and comprises four generator panels, two motor-generator panels, one balancer panel, one



View of Generating Plant (200-KW. Sets).

main instrument panel, five lighting-feeder panels, one B. of T. panel, one traction meter panel, and four traction-feeder panels. These panels are of blue Vermont marble, in three sections. As the plant is designed for a combined lighting and traction load, the main switches on the generator panels are of the three-pole double-throw type, to connect either machine with the traction or lighting bus-bars as required. The circuit breakers on these panels are specially designed, being both



Section of Rail Joint and Anchor Sole-Plate.

maximum and minimum combined. These panels also carry an ammeter for each machine, voltmeter connections, and field rheostat handwheel. The two motor-generator panels contain the necessary starting and main switches, circuit breaker, ammeter, and field rheostat handwheel, so arranged that the motor-generator may be used to generate current

either for lighting or traction. The B. of T. panel is fitted with the usual recording and testing instruments.

Each feeder panel is fitted with a main circuit breaker, ammeter, and integrating wattmeter.

The voltmeters on the two sides of the three-wire lighting system have open graduated scales and are of the illuminated type. The main voltmeters, one at each end of the board, for traction and lighting purposes, are of the illuminated-dial differential type, with centre zero for paralleling purposes. Messrs. Elliott Bros., London, supplied the recording instruments, and the illuminated-dial voltmeters and ammeters; the remainder of the instruments are of the latest Westinghouse type. The panels are carried on a wrought-iron frame, insulated from the floor and supported from the wall by insulators, a clear space of 3 ft. being allowed behind the board. The latter is mounted on a cantilever gallery, 8 ft. wide, above the engine room floor, the absence of columns giving clear access to the floor below, which is occupied by the balancer and motor-generator.

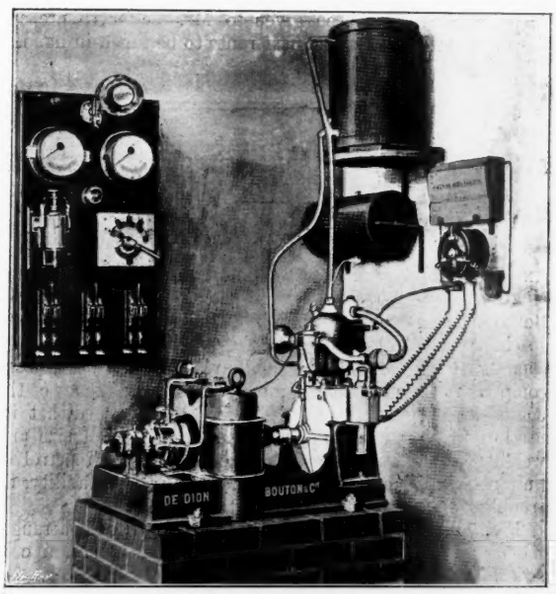
A 15-ton travelling crane traverses the whole length of the engine room; it was furnished by Messrs. Carrick and Sons, of Edinburgh.

Two new Lancashire boilers are provided, capable of working at a pressure of 160 lbs.; at present they are kept at a pressure of 135 lbs. per sq. in. to agree with the working pressure of the old boilers. The new boilers are 30 ft. by 8 ft., with Hopkinson fittings. The wrought-steel steam pipe, with welded flanges, is by Messrs. Stewart & Menzies, of Glasgow.

Four Körting ejector condensers are used, one to each engine; these are fed with condensing water from a cast-iron tank with a capacity of 42,000 gallons, placed at a height of 25 ft. above the level of the engine floor. The water used for condensing purposes is pumped from the Lancaster and Kendal canal, which is on the easterly side of the station, by two motor-driven Gwynne centrifugal pumps. Each condenser is fitted with Körting's automatic relief valve and shutter, and automatic exhaust to atmosphere. The motors used in pumping are of the enclosed type, made by Messrs. Hall & Son, of Oldham, and coupled direct to the pumps, which are each capable of lifting 1,000 gallons per minute from the canal into the tank. The boilers, pipes, condensers and valves were supplied by Messrs. James Foster & Sons, Preston.

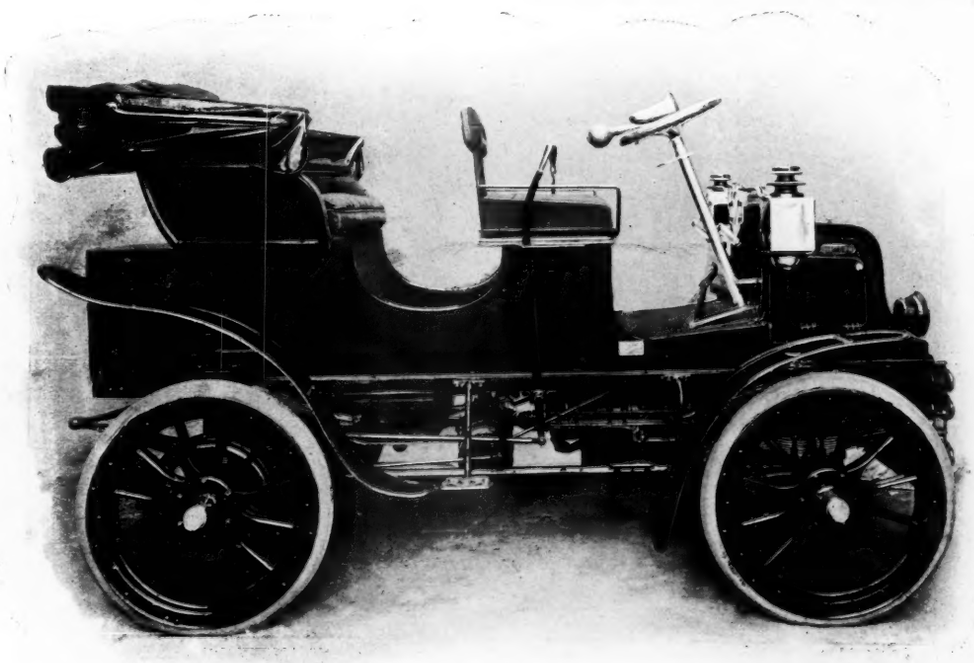
A Meldrum refuse destructor and boiler is working alongside the station, at a steam pressure of 200 lbs. per sq. in. The steam from the destructor is taken through a reducing valve at a pressure of 135 lbs. per sq. in.

The boilers and pipes are lagged with Messrs. Lonsdale Bros.' patent cork covering, the flanges being covered with planished sheet steel boxes packed with silicate cotton.



Automobiles at the Crystal Palace: Fig. 7.

By an arrangement with the British Westinghouse Co., the bodies of the cars were made at the Lancaster works of the Metropolitan Wagon Co., the desire of the Corporation being to encourage local trade as far as possible. Mr. Ernest Ireland, of Morecambe, contracted for the laying of the rails. The excavations, concreting, and cable laying were carried out by the Lancaster Corporation employés, under the direction of the Electricity Department. The buildings, the power station and car shed, were erected by Mr. W. Harrison, builder, Lancaster. The whole of the work has been carried



Automobiles at the Crystal Palace: Fig. 9.—City and Suburban Petrol-Electric Car.

out to the specifications of Mr. W. A. Tester, the electrical engineer, who has had much experience in the installation of electric tramways in different parts of the country. Mr. Tester has received valuable assistance from Mr. D. A. Hamilton (chief assistant engineer), who has worked with him throughout; and also from Mr. G. C. Litton, who acted as clerk of the works.

Instructions have been given to Mr. Tester to prepare plans and estimates for the next route to be taken in hand.

AUTOMOBILES AT THE CRYSTAL PALACE.

(*Concluded from page* 276.)

An exhibit somewhat apart from motor-cars is the combination petrol motor and dynamo shown by Messrs. De Dion-Bouton, 28, Brook Street, W. This firm has made a speciality of petrol motors, and the experience gained in the construction of the 30,000 which have been sold, justifies the company in drawing attention to the many advantages of the compact little generating set shown. It is claimed that its leading features are simplicity, cleanliness, small size and weight, also that owing to the ease with which petrol of uniform quality can now be obtained and its portability, no trouble need be experienced in that direction.

Fig. 7 shows a complete generating set, with the arrangement of water and petrol tanks, battery, induction coil, switch and switchboard.

The motor runs at a speed of 1,500 revolutions per minute; it is fitted with automatic lubrication to all parts, and electric ignition, and the parts are all interchangeable.

The dynamo is of the Manchester bipolar type, with drum-wound armature and shunt-wound fields.

A special feature of the combination is the electric regulator (in a shunt connected to the machine terminals), an exceedingly sensitive apparatus, by means of which the variations in voltage are said not to exceed 3 volts.

The arrangement consists of a solenoid acting on a conical plunger core, which is connected by means of a chain and pulley to a plug-cock in the pipe leading to the carburetter. The rotation of the cock consequent on a movement of the plunger regulates the amount of explosive mixture which is supplied to the engine. The sensitiveness of the regulator can be varied by means of a milled screw.

The following table gives the power and weight of the different types of the De Dion-Bouton electrical combinations:—

Power of motor.	Speed.	Volts.	Amps.	16-c.p. lamps.	Weight.
3½ h.p.	1,500	110 or 150	15 / 11	30	238 kg.
4½ h.p.	1,500		20 / 14	40	241 „
6 h.p.	1,500		30 / 22	60	349 „
8 h.p.	1,500		42 / 30	84	353 „

The combinations giving 150 volts are made for charging 60-cell accumulators.

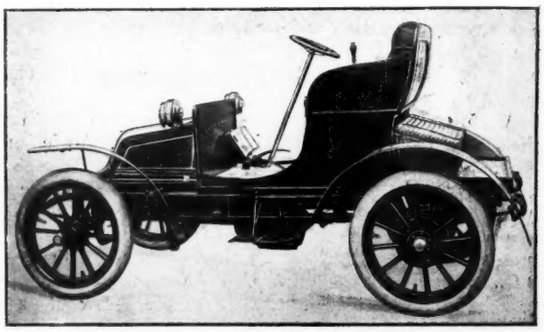


Fig. 8.

An exhibit of a character somewhat similar to the above was shown by the Wolseley Motor Co., of Birmingham. It consisted of a 4-h.p. horizontal petrol motor coupled to a compound or shunt-wound dynamo, running at 1,000 revolutions per minute. The engine is fitted with a centrifugal governor actuating a throttle on the feed pipe.

The ignition is electrical, a battery and induction coil being supplied. A silencer is also fitted to the exhaust. The weight of the complete set, with radiators, coils, batteries, &c., is 5½ cwt.

In our last issue we referred to several electrical cars at the Crystal Palace Show, descriptions of which were held over to this week. Among them the "P. & G." electric car (fig. 8) embodies some special features of interest. Built to seat two persons, the body is mounted on a tubular steel frame, with artillery pattern wheels fitted with pneumatic tires.

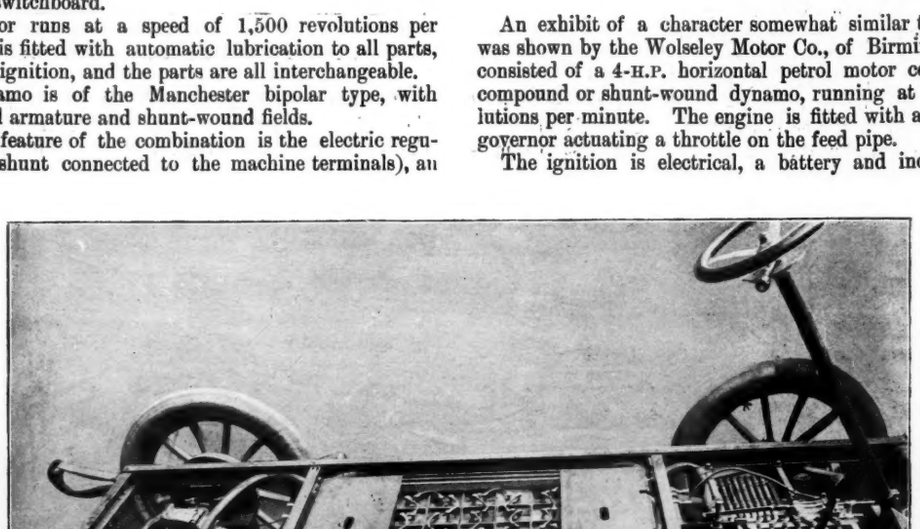


Fig. 10.—Chassis of the Electromobile Co.'s "1903" Car, showing Battery.

The battery consists of 40 cells, in ebonite boxes, of the firm's latest type, half of which are placed in front of the car, under the bonnet, and the remainder under the seat, an arrangement which provides an equal distribution of weight over the châssis. This battery will carry the vehicle about 40 miles on average roads with one charge.

The motor, which is designed for an output of from 2½ to 5 H.P., is substantially constructed, self-lubricating, and drives the rear axle through bevel gear.

The controller is arranged to give four forward speeds, ranging from 5 to 18 miles per hour, and two backward speeds; there are also provided electric head lamps, combined volt-ampere-meter, and all the usual accessories. This firm also makes a speciality of petrol-driven cars.

A combination petrol-electrical vehicle was shown by the City and Suburban Electrical Carriage Co., together with several other vehicles of their well-known make.

This vehicle (fig. 9, p. 315) is somewhat of a novelty, and, as mentioned last week, is only the pioneer of the type which it is intended to put on the market.

Briefly, these carriages will be fitted with a petrol-driven four-pole dynamo, supplying energy at 120 volts, direct to twin motors mounted on the rear axle.

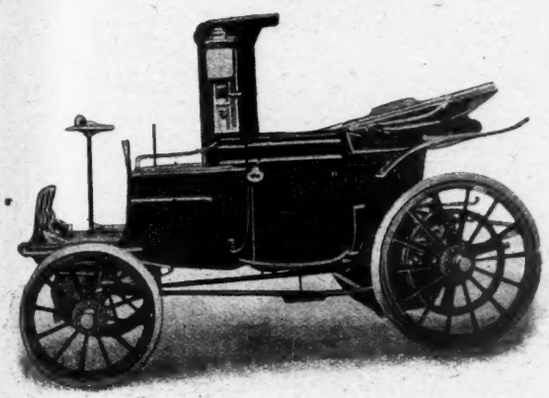


Fig. 11.

In parallel with the motors, there is provided a light and powerful battery of accumulators, which may be used to assist the ordinary driving power on steep gradients, and conversely will receive any surplus energy from the generator —in excess of that required for driving the car—the engine and dynamo running at a normal and most economical speed.

The body of this car is mounted on a straight steel frame, which also supports the petrol engine and dynamo in front, under the bonnet, and the accumulators at the back, under the seat.

A second tubular frame is provided for carrying the axles of the wheels and the motor equipment, and is connected to the body of the car through springs.

It will therefore be seen that two sources of power are available, either singly or in combination, *i.e.*, the vehicle can be propelled by the petrol engine, or by the auxiliary battery, or by the two together.

It is stated that the car on exhibition has given every satisfaction during some 750 miles of trial running in Somersetshire and Devonshire.

In our last issue we described the principal features of the Electromobile Co.'s 1903 type of carriage. We now illustrate (fig. 10) the straight châssis and under-slung battery, which form a distinctive feature of this company's type of vehicle.

Another exhibit briefly referred to in our last issue was the Scheele Electric Interchangeable Victoria-Coupé, shown by the Automobile Supply Co., Ltd., of 29, Great St. Helen's, London, E.C., and illustrated in fig. 11. This vehicle is elegant in appearance, and may be used either open or closed, according to the state of the weather. It is fitted with a battery of the Hagen Co.'s make, consisting of 40 cells in series, which are carried under the driver's seat and the rear portion of the body, and are of sufficient capacity to run the carriage, carrying four persons, from 40 to 50 miles with one charge, over average roads.

Two motors of about 2½-B.H.P. each drive through single-reduction spur gears, direct on to the rear driving wheels of the carriage, the motors being efficiently encased.

The vehicle is provided with a series-parallel controller of tramcar pattern, for regulating the speed, fixed horizontally below the driver's feet and operated from a handle on the steering column. Three speeds and a reverse, also a two-motion brake can be operated from this column, the brake being arranged by short-circuiting the motors on suitable resistances. A two-direction emergency brake and all the usual accessories are provided. This vehicle is so arranged that it is a comparatively easy matter to substitute a brougham body for the victoria, should it be so desired.

In glancing through the numerous exhibits of petrol-driven motor-cars, one cannot help noticing the almost universal use of electrical ignition devices. For this purpose accumulators and induction coils are most generally used in conjunction with a trembler or ignition points. Certain builders, however, employ a small magneto-machine, mounted directly on the engine shaft.

A typical car employing this method of ignition is built by the Albion Motor Car Co., of Glasgow. A couple of permanent magnets mounted on a magnet wheel on the engine shaft revolve round a fixed armature, from which a single wire is led to the ignition plug in the explosion chamber of the engine, the circuit being completed through the frame of the vehicle.

The contact-making device on the ignition plug is mechanically operated, and produces a series of brilliant sparks.

NEW COMPANIES REGISTERED.

Syro Switch Co., Ltd. (76,051).—This company was registered on January 14th, with a capital of £3,000 in £1 shares, to acquire the sole right to work in the United Kingdom British Patents No. 12,971, of 1900, and 1,344, of 1902, for improvements in electric switches and lampholders, to exploit any similar inventions, and to carry on the business of manufacturers of electrical switches and accessories, electrical engineers, &c. The first subscribers (each with one share) are:—G. Higginson, 81, Buckingham Gate, S.W., mechanical engineer; R. G. Orr, 2, Hampstead Hill Gardens, N.W., gentleman; F. R. Graves, 335, Fore Street, Lower Edmonton, N., clerk; H. A. Williams, 10, Westwell Road, Streatham Common, S.W., solicitor; H. F. Stanes, 16, Finsbury Circus, E.C., merchant; A. R. Stanes, 16, Finsbury Circus, E.C., secretary; and A. M. Woodd, 79, Marquess Road, Canonbury, N., engineer. No initial public issue. Registered without articles of association.

Electric Supply Co. of Ireland, Ltd. (2,717).—This company was registered in Dublin on January 17th, with a capital of £100 in £1 shares, to carry on the business of electrical engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—C. Fitzsimon, 30, Lower Ormond Quay, Dublin, electrical engineer; A. H. Walkey, 83, Grosvenor Square, Dublin, clerk; R. J. Smyth, 15, Synge Street, Dublin, clerk; R. Patterson, 7, Bath Avenue, Dublin, clerk; L. A. Rudd, 60, St. Laurence Road, Clontarf, Dublin, clerk; W. B. Biddell, 13, York Terrace, Phibsborough, Dublin, accountant; and W. Moroney, 23, Victoria Street, Dublin, clerk. Registered without articles of association. Registered office:—30, Lower Osmond Quay, Dublin.

Anglo-Iberian Electric Light and Power Co., Ltd.—(76,053). This company was registered on January 14th, with a capital of £10,000 in £1 shares, to carry on in Spain or elsewhere the business of an electric light and power company in all its branches, and to construct, lay down and establish any cables, wires, lines, lamps, works, &c., necessary for such purpose. The first subscribers (each with one share) are:—G. Davies, 66, Finsbury Park Road, N., merchant; C. W. Butler, 55, Bloomfield Road, Maida Vale, W., secretary; E. Courtier, 75, Cromwell Avenue, Highgate, N., clerk; R. Kirk, 2, Princes Mansions, Liverpool Road, Highbury, N., engraver; O. S. Hickson, 20, West Smithfield, E.C., solicitor; A. M. Laredo, 103 & 104, Dashwood House, E.C., merchant; and D. Hawes, 26, Percy Road, Shepherd's Bush, W., clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £10.

Ledbetter & Co., Ltd. (76,188).—This company was registered on January 27th, with a capital of £2,000 in £10 shares, to take over the business carried on at Leicester as "J. H. Ledbetter & Co." and to carry on the business of producers and suppliers of electricity for light, heat, ventilation, power or other purposes, electricians, engineers, manufacturers of magnetic and galvanic apparatus, &c. The first subscribers (each with one share) are:—J. H. Ledbetter, 108, East Park Road, Leicester, electrician; Mrs. M. M. Ledbetter, 108, East Park Road, Leicester; A. W. Rose, 48, Beckingham Road, Leicester, clerk; Mrs. C. Rose, 48, Beckingham Road, Leicester; R. A. Rose, 48, Beckingham Road, Leicester, clerk; Lily Rose, 73, Deacon Street, Leicester, electrician; and A. J. Rose, 73, Deacon Street, Leicester, confectioner. No initial public issue. The subscribers are to appoint the first directors; qualification and remuneration as fixed by the company. Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

Electric Danite Syndicate, Ltd. (76,275).—This company was registered on February 3rd, with a capital of £5,000 in £1 shares, to adopt an agreement with F. Fowles, and to carry on the business of advertising agents, manufacturers of and dealers in advertising appliances and accessories, &c. The first subscribers (each with one share) are:—R. J. Toleman, 22, Walbrook, E.C., consulting engineer; F. Fowles, 35, Duke Street, Brighton, advertising contractor; T. G. Chance, 129, Hopton Road, Streatham, gentleman; J. W. Robertson, 22, Walbrook, E.C.; R. Diespecker, 22, Walbrook, E.C., engineer; A. H. Payn, 14, Saragota Road, Clapton, N.E., clerk; and H. W. Green, 7, Freshville Gardens, Shepherd's Bush, W., clerk. No initial public issue. The number of directors is not to be less than two nor more than three; the first are R. J. Toleman, Captain R. Diespecker, and T. G. Chance; qualification, one share remuneration, £250 per annum, and a share in the profits, divisible.

Simplified Underground Conductor Co., Ltd. (76,331).—This company was registered on February 9th with a capital of £20,000 in £1 shares (12,000 ordinary, 7,000 preferred ordinary and 1,000 "employés"), to acquire British patents, Nos. 3,935 and 26,524, of 1901, and U.S.A. patent, No. 696,737, dated April 1st, 1902, for improvements in the laying of underground conductors for the distribution of electrical energy, to adopt an agreement with F. Jones, and to carry on the business of electrical engineers, electricians, telephone and telegraph proprietors, suppliers of electric light, heat and power, &c. The first subscribers (each with one share) are:—R. Jones, 51, Pembroke Place, Liverpool, builder; Mrs. J. Jones, 51, Pembroke Place, Liverpool; F. Jones, 30, Dudley Street, Liverpool, cement merchant; W. N. Jones, Glenbrook, West Kirby, gentleman; J. Hosie, 31, Handfield Street, Everton, Liverpool, clerk; J. Mottershead, 29, Royal Street, Kirkdale, Liverpool, clerk; and S. R. Hernan, 101, Barrington Road, Liverpool, clerk. Minimum cash subscription, £2,000. The first managers are F. A. Pocklington, 53, Castle Street, Liverpool, and A. W. S. Pocklington, Northumberland Club, London; remuneration, £500 each per annum.

City and Suburban Electric Carriage Co. (1903), Ltd. (76,967).—This company was registered on February 12th, with a capital of £152,000 in £1 shares (2,000 deferred), to acquire the business carried on by P. E. Singer, of 19, Kensington Court, London, at Niagara, York Street, Westminster, and elsewhere, as the City and Suburban Electric Carriage Co., and to carry on the business of manufacturers of, dealers in, and proprietors of motor conveyances and appliances, whether to be worked by electric, steam, oil, petrol, gas, or other power, manufacturers of horse-drawn vehicles, constructors and owners of power houses, garages, works, depôts, storehouses, and trial grounds, electricians, engineers, producers and suppliers of electricity, electric power, petrol, oil gas, or other power or light, manufacturers of electrical and other apparatus and machinery, railway, tramway, omnibus and conveyance proprietors, contractors, &c. The first subscribers (each with one share) are:—J. F. Cooke, 62, Ardgowan Road, Catford, S.E., clerk; J. C. Fay, 31, Kilmaine Road, Fulham, S.W., clerk; J. W. Ward, 14, Marney Road, Clapham Common, S.W., clerk; J. Cawdry, 150, Praed Street, W., clerk; J. W. Paget, 48, Harbour Square, Stepney, E., clerk; T. F. Stevens, 20, Gerda Road, New Eltham, Kent, clerk; and E. E. Ford, 25, Agnew Road, Honor Oak Park, S.E., secretary. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £500 ordinary shares; remuneration, £200 each per annum.

Taunton Electric Traction Co., Ltd. (76,319).—This company was registered on February 7th, with a capital of £50,000 in £5 shares (5,000 preference), to carry on in the United Kingdom, or elsewhere, the business of carriers of passengers and goods, electrical engineers, electricians, engineers, contractors, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, mechanical and chemical engineers, generators, accumulators, transmitters, users and suppliers of light, heat, sound and power, or any of them, by electricity, galvanism, magnetism, compressed air, gas, steam or oil or otherwise, manufacturers of and dealers in plant, machinery and implements for use in connection with the company's business, owners and workers of inventions relating to the propulsion of railway and tramway cars, carriages, trucks, boats and other vehicles or craft by means of electricity or other power, &c. The first subscribers (each with one share) are:—C. H. Dade, Donington House, Norfolk Street, W.C., secretary of the British Electric Traction Co., Ltd.; W. F. Cox, 60, Chancery Lane, W.C., solicitor; N. U. Gray, Donington House, Norfolk Street, W.C., secretary; S. A. Sillens, Donington House, Norfolk Street, W.C., barrister; H. Colbourne, Donington House, Norfolk Street, W.C., secretary; F. C. Cocking, Donington House, Norfolk Street, W.C., registrar; and S. R. Booth, Donington House, Norfolk Street, W.C., secretary. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 1 share; remuneration, £50 each per annum and 5 per cent. of the dividend on the ordinary shares, divisible. Registered office, Donington House, Norfolk Street, W.C.

W. & E. Sumner & Clementson, Ltd. (76,365).—This company was registered on February 11th, with a capital of £5,000 in £1 shares, to to take over the business of mechanical and electrical engineers, patentees, and manufacturers of electrical appliances, &c, carried on by W. & E. Sumner at Liverpool and elsewhere. The first subscribers (each with one share) are:—W. Sumner, 25, Westbourne Road, West Kirby, electrician; E. Sumner, 9, Grange Road, West Kirby, electrician; J. Clementson, Dacre House, Seabank Road, Liscard, merchant; A. Graves, 26, King Street, Waterloo, commission agent; J. West, 10, Cook Street, Liverpool, chartered accountant; W. S. Deyers, 27, Ashfield, Wavertree, accountant; and P. Jones, 19, Bremner Street, Liverpool, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the first are W. Sumner, E. Sumner, and J. Clementson (all permanent); qualification, 50 shares.

British Electric Transformer Co. (1903), Ltd. (76,351).—This company was registered on February 10th with a capital of £125,000 in £1 shares (50,000 preference), to acquire the business of engineers and manufacturers of electrical machinery carried on at Hayes, Middlesex, as the "British Electric Transformer Manufacturing Co., Ltd.," with the English and foreign patent rights belonging to the said company in connection with electrical transformers, and all improvements therein, with a view thereto, to adopt an agreement, dated February 5th, 1903, between said old company of the first part, A. M. Billington of the second part and P. W. Taylor (for this company) of the third part, to use, exercise, develop, grant licenses in respect of or otherwise turn to account an invention of A. F. Berry, in connection with electrical transformers, and to carry on the business of electrical engineers, electricians, manufacturers of electrical transformers, iron, brass and metal founders and fitters, machine and engineering tool makers, mechanical engineers, boiler makers, millwrights, metal workers, plate makers, metallurgists, chemists, &c. The first subscribers are:—A. F. Berry, Hayes, Middlesex, engineer, with 500 preference shares; E. Phillips, Basildon House, Moorgate Street, E.C., merchant, with 500 preference shares; A. M. Billington, Blomfield House, London Wall, E.C., engineer, with 500 preference shares; R. S. Bain, 25A, Cockspur Street, S.W., chartered accountant, with 500 preference shares; T. Petersen, Hamilton House, Victoria Embankment, W.C., engineer, with 500 preference shares; J. Blair, 40, Pall Mall, S.W., solicitor, with 1 preference share; and G. Barnett, 2, Augustus Road, Shepherd's Bush, W., shorthand writer, with 1 preference share. Minimum cash subscription 10 per cent. of any shares offered to the public. The number of directors is not to be less than three nor more than seven; the first are R. S. Bain, T. Petersen, A. M. Billington, E. Phillips, and A. F. Berry; qualification 500 shares; remuneration £750 per annum and 10 per cent. of the net profits remaining after payment of 10 per cent. dividend on the ordinary shares dividend. Registered office, Dacre House, Victoria Street, Westminster, S.W.

Prested Miners' Gas-Indicating Electric Lamp Co., Ltd. (76,081).—This company was registered on January 17th, with a capital of £12,500 in £1 shares, to acquire from the Prested Gas Indicator Syndicate, Ltd., and H. G. Prested, certain inventions for apparatus for indicating the presence of dangerous gases, patented in England, Belgium, France and the U.S.A., and for a miners' gas-detecting electric lamp, provisionally protected, to develop such inventions and to carry on the business of electricians, engineers, lamp manufacturers, &c. The first subscribers are:—S. W. Endicott, Crescent Road North, South Woodford, woollen merchant, 100 shares; J. Moule, Snells Park, Edmonton, clerk to Board School, 100 shares; C. A. Huni, 3, Marlborough Road, St. John's Wood, N.W., secretary, 100 shares; H. G. Prested, 44, Brecknock Road, N.W., electrical engineer, 100 shares: C. M. Wheeler, 336, Camden Road, N., licensed victualler, 100 shares; W. S. Hogg, 20, Bucklersbury, E.C., chartered secretary, 50 shares; D. W. Wright, 229, Camden Road, N., surgeon, 50 shares; and W. G. Wilson, 19, Sydney Road, Hornsey, N., traveller, 100 shares. Minimum cash subscription, £3,000. The first directors are J. Moule, C. A. Huni, J. Oxendale, W. G. Wilson and H. G. Prested, all of whom (except J. Oxendale) are the directors of the Prested Gas Indicator Syndicate, Ltd.; qualification, 100 shares; remuneration as fixed by the company. Office, 268—70, Mansion House Chambers, E.C.

North-Western Electricity and Power-Gas Syndicate, Ltd. —(76,121). This company was registered on January 21st, with a capital of £10,000 in £100 shares, to promote or aid in promoting a Bill for carrying on throughout Cheshire, that portion of Staffordshire lying north of the southern boundary lines of the rural districts of Tutbury, Uttoxeter, Stafford and Gnosall, that part of Derbyshire lying north-west of the boundary between the Unions of Chapel-en-le-Frith and Bakewell, that portion of Flintshire comprising the borough of Flint, the urban districts of Buckley, Connah's Quay, Mold and Holywell, and the rural districts of Holywell and Hawarden, and that portion of Denbighshire comprising the borough and rural district of Wrexham, and elsewhere, the business of an electricity and power-gas supply company in all its branches, and to carry on the business of electricians, electrical and general engineers, suppliers of electricity and power gas for any purpose, &c. The first subscribers are:—T. W. Twyford, Whitmore Hall, Newcastle, Staffordshire, potter, 5 shares; H. M. Robinson, Beechfield, Stoke-on-Trent, china manufacturer, 5 shares; R. Heath, Biddulph Grange, Congleton, ironmaster, 5 shares; F. Rigby, Westmore Lodge, Alsager, Cheshire, colliery proprietor, 5 shares; A. Bailey, Shelton, Stoke-on-Trent, timber merchant, 5 shares; S. T. Perry, Stone, Staffordshire, boot manufacturer, 2 shares; and C. E. Babb, Stone, Staffordshire, draper, 1 share. Minimum cash subscription £5,000. The first directors are T. O. Callender, J. H. Gartside, R. Heath, F. Rigby, E. Schweich, T. W. Twyford, A. Seymour-Jones, J. H. Derby and J. Harding; qualification, £200; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ashton, Frost & Co., Ltd. (Electrical and General Engineers, Blackburn) (9,482).—A trust deed dated January 8th, 1903, to secure £18,000 (with power to create and issue £10,000 further stock ranking *pari passu* therewith, on certain conditions), has been registered. Property charged: Freehold lands at Whalley Banks, Blackburn (7,034½ superficial square yards), a yearly rent-charge of £21 0s. 10d., and, as a floating security, the company's undertaking and property, present and future, including uncalled capital. Trustees: H. W. Pearson, West Garth, Malton; R. Peasson, Helmsley; and A. L. Russell, Malton.

North-West London Electric Supply Co., Ltd. (75,054).—£30,000 debentures (600 of £50 each), dated January 12th, 1903, and a trust deed dated December 22nd, 1902, have been registered. Property charged by debentures: The company's undertaking and property, present and future, including uncalled capital. Property charged by trust deed: Goodwill of electric lighting business; leasehold property known as central station, Finchley Road, Hampstead, and 2, Rosemont Road, Hampstead; book debts, stock, plant, cables running through public thoroughfares, outstanding orders, &c. Trustees: A. Bull, Finsbury House, E.C., and H. Hoare, 37, Fleet Street, E.C.

Newcastle-upon-Tyne Electric Supply Co., Ltd. (27,997).—Issue on December 30th of £1,500 debentures, part of a series created October 3rd, 1901, to secure £250,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series, £188,800.

Guildford Electricity Supply Co., Ltd. (36,725).—Issue on January 20th of £500 debentures, part of a series created November 19th, 1900, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Total amount previously issued of same series, £11,700.

Automatic Electrical Advertising Syndicate, Ltd. (62,115).—This company's annual return was filed on January 6th, when the entire capital of £4,500 in £1 shares had been taken up. £1 per share has been called up and paid on 3,000, and 1,500 shares are considered as fully paid. Mortgages and charges: nil.

Atlas Engineering Co., Ltd. (64,320).—This company's annual return was filed on December 5th, when 810 shares were taken up out of a nominal capital of £2,000 in £1 shares. £1 per share has been called up, and £810 has been received. Mortgages and charges, £300,

Nernst Electric Light, Ltd. (60,807).—This company's annual return was filed on January 6th, when 139,480 preference, and 180,000 ordinary shares had been taken up out of a nominal capital of £320,000 in 140,000 preference and 180,000 ordinary shares of £1 each. £1 per share has been called up on 115,000 shares, and £114,718 15s. has been received. £281 5s. remains in arrears, 25,000 preference and 180,000 ordinary shares are considered as fully paid. £288 15s. has been paid on 520 forfeited shares. Mortgages and charges: Nil.

National Electric Engineering Co., Ltd. (42,605).—This company's annual return was filed on January 2nd, when 2,659 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1 has been called up and paid on each of 654 shares. 2,005 are considered as fully paid. Mortgages and charges: Nil.

New Phonopore Telephone Co., Ltd. (44,054).—This company's annual return was filed on November 20th, when 5,111 ordinary and 1,000 founders' shares had been taken up out of a nominal capital of £10,000 in 9,000 ordinary and 1,000 founders' shares of £1 each. 10s. per share has been called up on the ordinary shares, and £2,555 10s. has been paid. 1,000 founders' shares are considered as fully paid. Mortgages and charges: Nil.

C. & A. Musker (1901), Ltd. (Hydraulic and Electrical Engineers, &c., Liverpool) (70,573).—Issue on January 5th of £4,800 debentures, part of series created July 5th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. Total amount previously issued of same series, £35,200.

New Century Arc Light Co., Ltd. (67,849).—A mortgage or charge dated December 19th, 1902, to secure a sum not exceeding £5,000 (being further security for £3,000 and upwards already advanced and future advances), constituting a second and floating charge on the company's property, present and future, including uncalled capital, has been registered. Holder: Baron de Bush, Ash Grove, Hackney. No trustees.

Aberystwyth and Chiswick Electricity Supply Corporation, Ltd. (38,854).—Issue on January 21st of £1,800 debentures, part of a series created by resolutions of November 2nd, 1900, and March 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: W. C. Johnson, Victoria Works, Old Charlton, Kent. No trustees. Total amount previously issued of same series, £23,200.

City of Birmingham Tramways Co., Ltd. (49,548).—A mortgage or charge, dated January 8th, 1903, supplemental to a trust deed dated January 29th, 1897, to secure £500,000 debentures created by resolution of September 30th, 1896 (£300,000 of which have been issued), has been registered. Property charged: Freehold property at Birmingham, King's Heath, Moseley Green, Handsworth, and Selly Oak; leasehold property at Birmingham, King's Heath, Birchfields, Herborne, Sparkhill, Selly Oak and elsewhere, tramways held under six leases from the Corporation of Birmingham, tramways and parts of tramways authorised by and constructed under various orders and the City of Birmingham Tramways Act, 1897, and other property, present and future, including uncalled capital. Trustees: J. A. Christie, The Chantry, Stanmore, and Sir C. R. Wilson, G.C.M.G., 21, Pont Street, London.

ELECTRICITY SUPPLY ACCOUNTS.

Leith Corporation Electricity Accounts.

We present herewith the accounts for the electrical department of the Borough of Leith for the year ending March 15th, 1902. The undertaking is comparatively young, this being its third year, but its output of 946,650 units is an excellent omen for the future. The capital account stands at £76,247, an increase of £20,839, or nearly 40 per cent. on the previous year, which was largely expended on mains and other plant which does not become productive for some time.

Great credit is therefore due to the late engineer, Mr. J. Gray Scott, through whose energy and good management the department was enabled to show such a small deficit as £188.

General Statement.

Year ending March 15th—	1900.	1901.	Inc.
Total capital expenditure	£55,408	£76,247	£20,839
Units sold, private	343,352	505,809	162,457
Units sold, public	—	440,841	—
Total number of units sold	—	946,650	—
Number of 30-watt lamps connected	26,126	40,278	14,152
Number of public lamps (10-ampere)	167	223	61
Maximum load in KW.	386	546	160
Capacity of plant in KW.	640	990	350

Revenue.

	Per unit.	Gross.	
Sale of energy	2·59d.	£10,203	
Meter rents	·00d.	24	
Sundry receipts	·02d.	352	
Gross revenue	2·61d.	—	£10,579

Expenditure.

	Per unit.	Gross.	
Coal	·55d.	£2,192	
Oil, waste, water, and engine room stores	·04d.	158	
Salaries and wages incurred in generation and distribution and attending to public lamps	·37d.	1,469	
Repairs and maintenance of buildings, engines, boilers, dynamos, and street lamps	·18d.	745	
Works costs	1·15d.	£4,564	
Rent, rates, and taxes	·13d.	513	
Managment expenses, salaries of managing engineer and clerical staff	·07d.	305	
General establishment charges, stationery and printing, law charges and insurance	·13d.	519	
Gross expenditure	1·50d.	—	£5,903

Profit.

Interest on mortgage and loans	£2,266	
Sinking fund	2,558	
Provision for bad debts next account ...	40	
Debit balance	— 188	
Gross profit	—	£4,676

The prices charged are:—For lighting, 4d. per unit; for power, 1½d. per unit; and discounts are allowed in both cases. The burgh arc lamps are charged at £20 per lamp per annum.

The average price obtained from the sale of energy for all purposes was 2·59d. per unit. This low figure is, however, easily explained by the low price per unit charged for lighting.

The items of expenditure on works costs, &c., will bear favourable comparison with other undertakings having a similar output.

The amounts set aside for interest and sinking fund, are proportionately heavier this year, which accounts for the undertaking showing a debit balance of £188.

Blackpool Corporation Electricity Accounts.

The returns of the electrical undertaking of the Borough of Blackpool show a substantial improvement on those of the previous year. The gross profit shows an increase of £1,846 on the previous year (which, on that occasion, was a decrease of £618 on the year before), and although the increase in revenue is not quite in the same ratio as in the previous year, the expenditure increase is only £2,535, as against £5,650 on that occasion. With the capital expenditure still rapidly advancing, it is satisfactory to record a greater increase in output than on any previous occasion, and Mr. C. Furness, the borough electrical engineer, is to be congratulated on the results of the past year.

General Statement.

Year ending March 31st.	1901.	1902.	Inc.
Total capital expenditure ...	£145,094	£171,033	£25,939
Units sold, private	—	924,415	—
Units sold, public	—	289,659	—
Units sold, traction	—	804,058	—
Total number of units sold ...	1,515,366	2,018,132	502,766
No. of 35-watt lamps connected	—	104,630	—
Maximum load in KW.	1,460	1,625	165
Gross revenue	£23,530	£27,911	£4,381
Gross expenditure...	£16,185	£18,720	£2,535
Gross profit	£7,345	£9,191	£1,846
Average price per unit sold ..	3·36d.	3·32d.	— ·04d.

The average price per unit shows a decrease—but less than might have been anticipated from the large increase of energy taken for traction purposes.

The progress of the output of the undertaking may be gauged by the following table:—

In the year 1895 ...	277,427	units were generated.
„ 1896 ...	473,824	„ „
„ 1897 ...	575,904	„ „
„ 1898 ...	903,558	„ „
„ 1899 ...	1,098,603	„ „
„ 1900 ...	1,427,607	„ „
„ 1901 ...	1,760,459	„ „
„ 1902 ...	2,262,516	„ „

The prices charged are as follows:—Private lighting, 7d. and 2d.; power, heating, &c., 2½d. per B.T.U. (Wright's D.I. system). Churches, 5d., and public lighting (average) 3½d. per B.T.U. Traction, 2d. up to 250,000 units and 1½d. afterwards.

There are 265, 10-ampere arc and 290, 8-C.P. incandescent public lamps.

The total number of consumers is 930, and the capacity of the works plant 3,050 KW.

There are some 90 miles of mains laid in the borough.

Revenue Statement.

Year ending March 31st ...	1901. Gross.	1901. Per unit.	1902. Gross.	1902. Per unit.	Inc.
Sale of energy	£21,186	3·36d.	£25,578	3·04d.	— ·32d.
Meter rents	—	—	—	—	—
Sales of material and attendance to public lamps	1,437	·23d.	1,281	·15d.	— ·08d.
Sundry fees, premiums, &c. Interest and sinking fund on public lamps capital.	907	·14d.	1,053	·12d.	— ·02d.
Gross revenue ...	£23,530	3·73d.	£27,912	3·31d.	— ·42d.

The works costs has fallen by over ¼d. per unit generated, largely owing to the decreased cost of coal, which had been rising for the past few years. Repairs is the only item showing an appreciable increase. The total cost per unit has fallen to 2·21d., being practically the same as two years ago.

Cost of Production.

	1901. Gross.	1901. Per unit.	1902 Gross.	1902 Per unit.	Inc.
Coal and coke	£7,967	1·22d.	£8,445	1·00d.	— ·22d.
Oil, waste, water, &c.	1,341	·21d.	1,210	·14d.	— ·07d.
Salaries and wages incurred in generation and distribution and attending to street lamps.	2,332	·37d.	2,359	·28d.	— ·09d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c., and public lamps.	2,820	·45d.	4,612	·55d.	+ ·10d.
Works costs ...	£14,190	2·25d.	£16,626	1·97d.	— ·28d.
Rent, rates and taxes ..	489	·08d.	572	·07d.	— ·01d.
Management expenses, salaries of engineer, secretary and clerks.	933	·15d.	367	·04d.	— ·11d.
General establishment charges, stationery and printing, law charges and insurance.	385	·06d.	975	·11d.	+ ·05d.
Sundry expenses	188	·02d.	180	·02d.	·00d.
Total costs ...	£16,185	2·56d.	£18,720	2·21d.	— ·35d.

The year's working shows a balance of £57, after setting aside £9,134 for the provision of interest and sinking fund and repayment of capital outlay.

Profit Statement.

Year ending March 31st—	1901.	1902.
Interest on loans	£4,270	£9,134
Sinking fund	3,280	
Net profit carried forward	— 205	57
Gross profit	£7,345	£9,191

CITY NOTES.

Blackheath and Greenwich District Electric Light Co.

The annual general meeting of this company was held on Thursday last week, at the Cannon Street Hotel.

Sir J. A. Willox, M.P., in moving the adoption of the report, said that the company had now passed through its initial stage. When a supply of energy was available in a new district, consumers came in slowly at first. The record of business as set forth in the report showed that progress had been steady and well maintained. In 1900 they had 342 consumers, in the next year the number was 746, and last year they had increased to 1,234. The number of lamps connected increased during the same period from 14,473 to 29,449, and last year to 44,916 lamps of 8 c.p. Continuing, the chairman said that though the primary object was the supply of light to business premises and private houses, it was not the only source of income. In the last report, the directors made special reference to the demand for power, and expressed their belief that it would become an important branch of the business. The forecast was being fully justified. During the past year the demand for power increased fourfold, and there was every indication that it would further develop. All the large consumers had, without exception, given extensive orders, even in cases where they had their own boilers and engines on the premises. He mentioned several instances supporting this statement. In one case a demand was received for a motor of about 100 kw. (probably the largest two-phase motor of its kind in the kingdom), and after some months' satisfactory working a second large motor was being put down on the same premises. These facts showed that manufacturers in the company's district were beginning to realise that it was more profitable to save their space and utilise their capital in the production of their own specialities than to incur trouble and expense in providing power for themselves. This provided the company with a day load when no lighting was required. The financial results of the year were satisfactory. The total receipts had grown rapidly, the rate of expenditure having decreased in a more marked ratio, and there was every reason to expect that this process would continue. The gross receipts were £14,334, and the expenses were less than half the revenue—namely, £6,978—leaving the credit balance at the end of the year £7,355. The chairman referred to the judicious and constant supervision of the managing director, Mr. Bowden; the board were under obligations to him for his services. The result of the year's operations was that, after providing for debenture and other interest charges, there was a net balance of £4,012. Continuing, Sir John dealt with certain points of a technical character. When the provisional order was first obtained the company was required to supply direct current in Greenwich and alternating current in Blackheath, and in practice this duplication of the system was found both inconvenient and expensive. The directors desired to unify the system of supply, and they accordingly applied to the Board of Trade to sanction the change-over in the Greenwich area from direct current to alternating current. As the greater portion of the current supplied had to be alternating, it was felt that if they were permitted to adopt this system of supply throughout the whole area it would effect a considerable saving of expenses. After much negotiation, the necessary permission was obtained. The work was being proceeded with as rapidly as possible. It would involve a small capital expenditure. The change would obviate the necessity of laying fresh trunk cables. The chairman then referred to the Bill now before Parliament. The Bill seeks to transfer to the company the present electric supply order for the districts of Lewisham and Penge. Lewisham was immediately contiguous to the company's area and could be supplied economically from their mains, and the prospects of a large demand were evident; many consumers were waiting to be supplied. The addition of this area would add materially to their field of operations without any very large expenditure. As to Penge, that district could not be so easily worked, and they were not so eager to secure it. The local authorities sought to impose onerous conditions, and unless satisfactory terms could be arranged this portion of the Bill might be dropped. While they would like to have the Penge district, they would not attempt to do so except on reasonable terms. Another part of the Bill related to the Crystal Palace Co.'s undertaking It was purely permissive. It proposed to allow the Blackheath Co. to buy and the Crystal Palace Co. to sell the latter's undertaking. The districts lay together, and their company could work the Crystal Palace area under more favourable conditions than now obtained. However, no compulsion was to be used. It would be a matter of amicable agreement. Of course, such terms, if arrived at, would be subject to the confirmation of the shareholders in both companies, so that nothing would be done in haste or in secret.

The motion for the adoption of the report was seconded by Mr. Henry St. John Winkworth. The report was unanimously adopted.

The retiring director and the auditors were re-elected.

An extraordinary meeting was then held, and the Bill referred to above was approved.

Liverpool Overhead Railway Co.

Sir Wm. Forwood presided over the half-yearly meeting, held on Tuesday last week. He said that the accounts were not as satisfactory as they could have wished, but, on the whole, they were more encouraging. They had completed the acceleration of their trains on October 1st last. Some details were wanting; the machinery was delivered rather slowly, and it was only in the last few weeks that they were able to give the public a six-minutes' service, but they had been practically working the accelerated service since October 1st. The accelerated service had been entirely satisfactory. Before they opened the service they had a decrease of £101 per week. This they had turned into a very large increase since the accelerated service was opened, of £72 per week. It was a bold step for the directors to take; so bold that electrical engineers, American engineers in particular, predicted that they would not succeed. They said openly that they (the directors) were attempting what was impossible. He was glad to think that they had accomplished everything they had attempted. Their speed was 19 miles per hour. On the Manhattan Railway it was 13½ miles; on the South-side Elevated Railway, Chicago, it was 14·6 miles; on the Chicago Lake-side, 12½ miles; on the South London, 13 miles; and on the Central London, the Twopenny Tube, it was 14 miles per hour; so they would see that with regard to speed the Liverpool Overhead Railway was far in advance of anything before attempted, and the directors were abundantly satisfied with the result of their expenditure of capital. The receipts for the half-year had been £41,159, as against £41,556, showing a decrease of £397. The expenditure had been £31,118, against £29,896. They would notice, on the other hand, that they had run rather less mileage, and that their expenses were increased owing to the accelerated service. They had carried to the reserve fund the sum of £2,000; in previous half-years they had only carried £1,500. There was also an increase in the cost of materials. That arose from the permanent way and renewal expenses. They had kept their structure and rails and electrical equipment up to date entirely out of revenue. They had never touched their renewal fund. The working expenses of the half-year worked out at 2 23 per cent. less than in June of last year. Three years ago the company obtained powers enabling them to join their line with the Lancashire and Yorkshire at Seaforth station, and he reported that negotiations had been going on, though they did not succeed in coming to terms. They had now arrived at the heads of an agreement; he was not able to give them particulars, but he thought they would shortly be connected to the Lancashire and Yorkshire Railway, and that the arrangements would be mutually advantageous. There had been deposited in Parliament by the Cheshire Lines Committee a Bill with regard to a junction with their line at the Hamlet, and they would shortly be asked to approve of that Bill. Another Bill had been deposited for making a line from Seaforth Sands to the Cheshire Lines station at Sefton, a loop line. They would also be asked to approve of that Bill. Their line had ceased to be an isolated item, and before long would be linked with main lines of railway, which must add to their prosperity. The competition with the Liverpool tramways was still severe, but they had won back a good deal of their traffic, and he was inclined to think they would soon win back more. They ran from one end to the other of their system in 20 minutes. He did not think it possible to give a better service than that. The chairman concluded by moving the adoption of the report.

Mr. Richard Hobson seconded.

The resolution was carried, as was also that declaring dividends of 5 per cent. on the preference and 1¼ on the ordinary shares.

At a special meeting which followed, resolutions were passed respecting the Cheshire lines, &c., also authorising the raising of £16,500 debentures. The chairman stated that the money would be required to meet the cost of extensions and to provide a new electrical conductor. By means of this new conductor the area given to the negative return current would be very much increased, and they would have an economy in fuel.

London United Tramways (1901), Ltd.

The directors' report submitted at the meeting held at Chiswick on Wednesday, 11th inst., states that during the year ending December 31st, 1902, great progress was made with the works of construction and equipment of the new lines. "Of the tramways under construction totalling 13 miles of route and 25¾ miles of single track, six miles of route have been opened for traffic; these comprise the extensions from Hounslow to Barrack Road, and from Isleworth and Richmond Bridge respectively to Twickenham Town, which were completed in September last, and the further extension from Twickenham Town on to Hampton Road and Teddington junction opened for traffic in November. The remaining portions of the Hampton Court group of lines through Hampton to Hampton Court returning through Hampton Wick and Teddington to the Hampton Road junction are practically completed, and will be ready for opening at Easter. The directors have secured an ample site of 10 acres at the most convenient point, *i.e.*, at the junction of the lines in Hampton Road, Teddington, upon which an extensive depôt, sub-station, car sheds and workshops have been erected, and these with nearly two miles of storage sidings to accommodate upwards of 200 cars, are now ready for the reception of the rolling stock. The new cars ordered last year are in process of delivery, and will all be in hand before Easter. Proposals were submitted last session for the approval of Parliament to authorise valuable extensions from Kingston-on-

Thames to Wimbledon, from Hammersmith Bridge *vid* Barnes and Mortlake to Richmond, and the electrical conversion of the company's existing horse tramway between Kew and Richmond, as also a line from the Uxbridge Road across to Hammersmith, which will give the company's passengers from Hanwell, Ealing and Acton a direct route to Hammersmith Broadway and the District Railway as an alternative to the existing terminus and interchange facilities at Shepherd's Bush. The Bill was strenuously opposed by the London and South-Western Railway and other important interests in both Houses of Parliament, but after protracted hearings extending over six weeks the directors succeeded in obtaining an Act of Parliament authorising the whole of their proposals, except the comparatively short piece of line in Bridge Road and Hammersmith Bridge, which the Commons Committee excised upon a representation by the London County Council that the laying of a tramway would necessitate the erection of a new bridge. Since the close of the session, however, the London County Council have intimated that their views are modified, and that they are applying to Parliament to authorise the construction of this short piece of line, but, recognising that in the public interests it should be worked by the company as part of a through route, they are prepared to lease the same to the company. The company's Act confirms the arrangement which the directors have carried through with the Richmond Corporation, extinguishing the option which would have arisen this year to purchase the existing horse tramways and provides that the enlarged system of electric tramways now authorised for the borough shall not be purchasable until at least 30 years hence. The Act also provides that the local authorities of Barnes and the Maldens and Coombe may not purchase before the expiration of 30 years, Wimbledon and Merton of 25 years, and then only at fair market value. The directors have also secured an extension of the purchase period with respect to the lines in Brentford for 25 years from 1903. Powers were also obtained authorising the company to enter into working agreements with railway companies for through bookings. The directors are pleased to be enabled to report to the shareholders such complete success in their Parliamentary proceedings of last session. An agreement has been sealed by the Middlesex County Council, and is in force until 1919, whereby they undertake not to promote tramways or light railways in the company's territory in Middlesex, to support the company's applications from time to time, and to oppose any other company or person promoting schemes within that area. During the past few months arrangements have been made for working in friendly relations with the Underground Electric Railways of London, Ltd., the company which controls the Metropolitan District Railway, the Great Northern, Piccadilly and Brompton Railway, the Baker Street and Waterloo Railway, and the Charing Cross, Euston and Hampstead Railway, in pursuance of which it is intended that all the allied railway companies and this company shall issue through tickets over the respective systems. In order that the shareholders may the better appreciate the importance of this alliance and the great volume of additional traffic likely to flow to this company's system, a map has been issued showing the various undertakings, which are so connected up as to cover practically the whole of London and its western suburbs. The Underground Electric Railways of London, Ltd., having become the largest shareholders in this company, their active co-operation will shortly be further assured by the election of representatives on this company's board of directors. The operation during the past year of that portion of the company's undertaking which has, so far, been opened for traffic, has resulted in gross receipts amounting to £222,256 15s. 10d., and the working and general expenses and renewals are £120,938 16s. 1d., leaving a net revenue of £101,317 19s. 9d. After payment of the debenture interest and the dividends on the 5 per cent. preference shares there remains £50,156 8s. 7d., out of which an interim dividend at the rate of 8 per cent. per annum, less income-tax, amounting to £22,552 12s. 7d. was paid in August last, leaving an available balance of £27,603 16s. Of this amount it is proposed to appropriate £23,346 2s. 3d. in payment of a final dividend on the ordinary shares for the half-year ending December 31st last, at the rate of 8 per cent. per annum, less income-tax, and to carry the surplus of £4,257 13s. 9d. to the credit of the next account. The total number of passengers carried during the year was 36,209,737. In view of the fact that the principal extension of the company's undertaking contemplated by the prospectus has as yet not been brought into operation, the shareholders will doubtless be gratified with the result of the first year's working. Whilst the extensions opened have only been so recently brought into traffic, and constitute the initial portions only of the through route, the receipts from them have been very satisfactory, and serve to emphasise the directors' views as to the large additional revenue which the company will secure immediately upon the opening of the completed route through the Thames Valley to Hampton Court. The directors will shortly determine which of the other groups of lines authorised, but not yet constructed, covering in all about 45 additional route-miles, shall be next taken in hand, and they will probably proceed with the lines over the Kingston and Hampton Bridges connecting up the Borough of Kingston-on-Thames and Surbiton with London."

The first ordinary meeting of the shareholders of this company was held on Wednesday last week at the offices, 88, High Road, Chiswick, Mr. George White, J.P., presiding.

The Chairman, in proposing the adoption of the report, said that since the new company commenced business 14 months ago, 13 miles of route and 25¾ miles of single track had been laid down. That, however, hardly conveyed the immense amount of work outside the actual laying of the lines, which had been accomplished. Many miles of cableways had been opened up and finished, and cables laid in. Hundreds of posts had been planted, and the whole of the trolley wires affixed, whilst many important works in street improvements had been carried out. Many of the roads through which they were about to run had been widened and improved almost past recognition; all that meant a very heavy charge upon the capital account, but in most instances they had secured a long term of years before any question of purchase by local authorities could arise, and even when it did in most of these cases the undertaking would have to be purchased at fair market value, that was upon the earning capacity. Some of them might perhaps be able to imagine, though hardly to gauge, what that was likely to be after the development of the Thames Valley during the next 25 or 30 years. Amongst the many improvements they were carrying out not the least important was in the Hampton Road, where from Garrick's Villa for half a mile or more along that road they were throwing a considerable slice of Bushey Park into the width of roadway and making a really noble avenue in place of the hitherto narrow roadway. The report spoke of the portions of the lines already opened and of the satisfactory receipts obtained so far, and it mentioned that the remaining portion of the Hampton Court group of lines would be ready for opening at Easter. When that, which he would call "Royal route," was opened, he looked forward to its becoming the pleasure line for the whole five or six millions of London's population. Let them remember the difficulties which the ordinary Londoner had had to surmount heretofore in order to reach Bushey Park, Hampton Court and the other beautiful spots in the Thames Valley, and then think of his being able to take an electric car either at Shepherd's Bush or Hammersmith Broadway every 2½ minutes from the first thing in the morning, and to be able to return at any equally quick interval up to midnight, on every day throughout the summer. In his opinion the traffic on many days would only be measured by their capacity to handle it, and on that score they need have no fear. Their arrangements would enable them on any and every day throughout the summer to readily take and bring back 100,000 passengers, and he ventured to believe that there would be many days on which their capacity would be taxed. If this were so, then the future of their revenue account would appear to be assured. They took on the lines which were in working last year upwards of £200,000, and carried 36 millions of people. They were only able to carry for comparatively short distances, and therefore to secure a small average fare for each passenger, but when the Hampton Court lines were opened they would receive 6d. for each through passenger, that is, ½d. a mile. It only required 100,000 passengers there and back 20 days in the course of the 365 to secure the balance of revenue which they estimated in their prospectus. Each Sunday last summer they averaged 150,000 for the day, it was true for shorter distances, but yet that fact was enough to instance the almost boundless possibilities of the traffic they would have to handle, and the moderation of any estimates they had hitherto put forward. Turning to their Parliamentary proceedings of last session, the report would have informed them of the great success which attended their efforts. The authorisation of the lines connecting up Kingston-on-Thames with Wimbledon; Richmond to Hammersmith Bridge *vid* Mortlake and Barnes, and the connecting line from Uxbridge Road to Hammersmith Broadway, could not fail to add materially to the value of their undertaking. The London County Council's lines finished at the county boundary, and they could not go beyond—they were in possession of both roads in Surrey from that point. That traffic would be very large, and was altogether in addition to the traffic which they would carry direct over their lines from the west of London. It was satisfactory, too, that they retained for at least 30 years to come their lines in Richmond, and had secured Parliamentary sanction, with the full approval of the Corporation, to their conversion and extension as electric tramways. The other subject of importance upon which he would touch was the arrangement made for working in friendly relations with the Underground Electric Railways of London, Ltd. Controlling, as they did, the Metropolitan District Railway, the Great Northern, Piccadilly and Brompton Railway, the Baker Street and Waterloo Railway, and the Charing Cross, Euston and Hampstead Railway, with numerous proposed extensions, it would be seen that they would afford to London a very complete underground railway service, and he regarded the arrangement, by which passengers over the whole of those railways and their electric tramways would be enabled to secure through facilities and fares, as the most important step ever taken in the interests of the travelling public of London. It went without saying that it must benefit all the companies concerned, and seeing that their territory comprised practically all the best residential and pleasure resorts, to the latter of which, at some time or other, all London wended its way, they certainly would obtain a great accession of traffic, whilst to have 75 miles of electric tramways as a gathering ground for the railways was an added strength to those undertakings. The accounts for the past year were very comprehensive, and gave every necessary detail. The result was a profit of £101,317, enabling them to recommend a final dividend of 8 per cent. per annum, which, with the interim dividend, made 8 per cent. for the whole year, and to carry forward £4,257 to the next account; he ventured to submit that as a highly creditable result for the first year, with portions only of their lines in work, which gave promise of an increasingly profitable future. In conclusion, the chairman remarked that for some time past he had looked forward with an anxious desire to somewhat reducing his engagements, and he felt he could now safely resign the chairmanship of the company, confident that the interests of the shareholders would not suffer, as he was to be succeeded in the chair by Mr. C. T. Yerkes, the chairman of the Underground Consolidated Electric Railways of London.

Mr. J. Clifton Robinson, the managing director, seconded the motion, and the report was adopted.

A special meeting was subsequently held, when resolutions altering the articles were confirmed.

Westminster Electric Supply Corporation.

The directors' report for 1902 says that the supply of current which on December 31st, 1901, was provided for the equivalent of 533,462 lamps of 8 c.p. had increased by December 31st, 1902, to the equivalent of 602,976 lamps. At the present time there are on circuit the equivalent of 608,974, and applications have been received for a further 8,028 lamps of 8 c.p.

The length of roadway in which continuous current mains have been laid, now exceeds 70 miles, making about 270 miles of ways, into which upwards of 220 miles of copper (strip and cable) have been drawn. In addition three miles of trunk mains (12 miles of ways) are laid in the company's area to connect the stations with the Central Electric Supply Co.'s station at St. John's Wood. The system of public lighting undertaken by this corporation has been completed, and continues to give great satisfaction. The first section of the station of the Central Electric Supply Co., at St. John's Wood is now finished and equipped with the necessary plant to meet the growing requirements of this company and the St. James' & Pall Mall Electric Light Co. This company commenced to take supply on November 20th last. An outlay of £16,104 9s. 8d. for interest and preliminary expenses has been incurred by the Central Electric Supply Co. It has been agreed between the directors of this company and of the St. James' and Pall Mall Co. that this amount should be discharged and paid by the two companies in equal shares. A sum of £1,260 8s. 4d. was taken into the accounts for the year 1901, and the balance, £7,091 16s. 0d. has been now taken into the net revenue account for the past year. For the consideration of the shareholders an abstract of the accounts of the Central Electric Supply Co., for the past year is enclosed. The reduced price at which the directors were able to place the present contract for coal has had a beneficial effect, for although, owing to increased output, nearly 5,000 tons more were used, the cost of coal was £1,663 less than for the previous 12 months. The result of the year's working is very satisfactory and the directors are pleased to be able to recommend the payment of an increased dividend and the carrying forward of a larger balance than previously. An interim dividend, at the rate of 11 per cent. per annum on the ordinary shares and the dividend on the 5 per cent. preference shares, for the half-year ending June 30th, 1902, has been distributed. After allowing for depreciation, sinking fund, &c., the net balance is £45,340 8s. 11d., from which must be deducted the second half-year's dividend on the preference shares which absorbed £3,296 10s. 4d., leaving a balance of £42,041 18s. 7d. Out of this the board recommend the payment of a dividend at the rate of 13 per cent. per annum, less income-tax, for the past half-year, carrying forward a balance of £8,695.

Statement of Electricity Generated, Sold, &c. (Westminster Electric Supply Corporation.)

Board of Trade units generated.	Quantity utilised.			Quantity expended in distribution.			Total quantity accounted for.	Quantity unaccounted for.	No. of lamps on circuit, December 31st, 1902.
	Sold to consumers.	Used on works for lighting, power, meter testing, &c.	Total.	In batteries.	In feeders.	Total.			
12,894,170	11,696,024	151,700	11,847,724	24,464	919,585	944,049	12,791,773	102,397	609,976

The meeting will be held at Eccleston Place next Wednesday.

Brompton and Kensington Electricity Supply Co.

The report for the year 1902 says that the revenue account shows a credit balance of £26,618 17s. 11d., which, with the balance of £2,961 12s. 10d. brought forward, and £314 13s. 7d. balance of interest received, makes a total of £29,895 4s. 4d. After deducting £3,492 12s. 8d. for interim dividend on the 7 per cent. cumulative preference shares, and £3,507 7s. 4d. interim dividend at the rate of 7 per cent. per annum for the half-year to June 30th on the ordinary shares, the directors recommend that the sum remaining, viz., £22,895 4s. 4d., be dealt with as follows:—

To credit of depreciation account	£7,000 0 0	
In extinction of goodwill account, patent rights and covenants (capital account, item No. 8)	7,000 0 0	
		£14,000 0 0
To payment of dividend on the preference shares for half-year ended December 31st		3,459 8 0
To payment of a dividend on the ordinary shares for the half-year ended December 31st at the rate of 9 per cent. per annum, making 8 per cent. for the year		4,547 8 1
Leaving a balance to be carried forward of		888 8 3
Total		£29,895 4 4

The following table shows the progress of the company's business:—

Year.	Equivalent of 35-watt (8-c.p.) lamps connected.	Increase in 35-watt (8-c.p.) lamps.	No. of customers connected.	Gross receipts.	Expenditure.	Net receipts.
				£ s. d.	£ s. d.	£ s. d.
1890	13,665	9,145	248	5,010 9 2	4,694 6 5	316 2 9
1891	19,388	5,723	373	8,328 3 11	6,077 14 10	2,250 9 1
1892	23,700	4,312	471	10,688 18 6	7,851 19 6	2,836 19 0
1893	28,429	4,729	599	12,063 10 10	7,832 6 8	4,231 4 2
1894	35,858	7,429	755	13,696 11 8	7,481 16 8	6,268 15 0
1895	44,162	8,304	922	15,394 16 11	8,554 0 10	6 840 16 1
1896	55,265	11,103	1,164	17,442 6 5	8,410 8 4	9,031 18 1
1897	66,364	11,099	1,416	20,810 10 1	8,777 5 2	12,033 4 11
1898	80,301	13,937	1,777	24,906 17 11	10,840 14 11	14,066 3 0
1899	95,803	15,502	2,112	30,416 13 4	12,235 16 10	18,180 16 6
1900	108,978	13,675	2,395	36,125 4 5	14,801 0 10	21,324 3 7
1901	121,212	12,234	2,650	41,154 4 6	16,905 2 8	24,249 1 10
1902	137,326	16,114	2,979	45,655 2 7	19,036 4 8	26,618 17 11

The meeting is to be held at Winchester House on Thursday, February 26th, at 3.30 p.m.

Consolidated Telephone Construction and Manufacturing Company.

The annual meeting was held at River Plate House, E.C., on Monday, and for such facts as are given in the following report we are indebted to the *Financial Times*.

Mr. Herbert Allen, who presided, moved the adoption of the report and accounts for the year ending March 31st last (!), and took upon himself a good deal of the responsibility for the delay in holding the meeting. He followed Mr. Jackson as chairman last autumn, and one of his first acts was to make a searching investigation. This naturally took some time, and at his request the meeting was allowed to stand over while negotiations proceeded with a view to an arrangement being arrived at which would put the company on a good financial basis. These negotiations occupied a longer time than had been expected, and eventually it was decided not to await their completion before calling the shareholders together. He did not expect any of the shareholders to be very enthusiastic over the accounts, because in one particular—and a very interesting and important particular—they were disappointing, and that was in so far as no dividend was recommended; but in many respects there was much in them that was of an encouraging and satisfactory nature. There was a fair trading profit shown—a profit equivalent to about 3½ per cent. on the capital of the company—and that, in what was supposed to be a struggling industrial company, was in some respects not a bad showing. The trading profit of £3,928, compared with £3,199 for the previous year—an increase of £729. The total revenue receipts for the year were £7,294, comparing with £5,430 for the previous year—an increase of £1,864. The loss occasioned through the floods at Coventry amounted to £3,850. The net revenue balance, after adjustments, was £2,497. Turning to the balance-sheet, the items of goodwill and plant and machinery had been slightly written up as a result of the purchase price of Williamson & Joseph, Ltd., having been spread over them. On the other side of the balance-sheet debentures figured at £6,700, this being part of the money with which the company purchased the Williamson & Joseph business. The whole of the loans—£5,526—had since been paid off, with the exception of £300, and they had now no loans of any kind, with the exception of the debentures. The auditor in his certificate pointed out that nothing had been charged in the accounts for depreciation, but that question did not arise, because they were not contemplating the payment of a dividend. In the case of a struggling company they could not be as particular as in the case of flourishing companies which scarcely knew what to do with their money. This whole question of the valuation of assets had been raised at previous meetings, and at the last meeting the chairman said he would consider whether a revaluation could be made by an independent valuer. The matter had been considered, and the board had come to the conclusion that no outside valuer was as competent to value the assets as were the company's own managers and staff—the practical people engaged in the business itself. Commenting upon the letter of a shareholder who had stigmatised the report as "wild and floundering," the chairman said he considered every paragraph in that document concise and instructive, and that there was nothing superfluous, immaterial, or misleading in it. The general feeling appeared to be that the directors were entitled to sympathy in their difficulties.

Mr. C. Woolley seconded the motion.

Mr. Ritherdon moved that the report and accounts be not passed, but that a Committee be appointed to inquire and report fully to the shareholders. He expressed dissatisfaction with regard to the valuation of the stock, and also of the loss occasioned through the floods at Coventry. He pointed to the auditor's certificate as justification for the amendment, and declared that there was no excuse for the directors having delayed the issue of the report—it was a scandalous thing.

Mr. W. R. Lawson said that the statement of accounts submitted was most impudent and misleading, and he congratulated the new chairman upon the courage he possessed in coming forward on behalf of directors who had not the courage to present their own accounts. He ridiculed the idea of there having been a trading profit of the amount mentioned, and contended that in the three years they had been in office, instead of making a trading profit from the manufacture of telephones, they had been losing from £600 to £1,100 a year. He proposed that the accounts be not adopted, and that the meeting be adjourned until May 18th for the presentation of the accounts for the current year.

The Chairman ruled Mr. Ritherdon's amendment out of order.

Mr. Spencer expressed the opinion that there should be an independent valuation of the stock, &c.

Mr. R. Whieldon Barnett pointed out that if, as suggested, the valuation of the damage done by the flood were too high, it meant that the trading profit must be greater accordingly.

The Chairman assured the meeting that there was no one who could have been called in from outside who could have estimated the loss incurred by the damage referred to. The loss could only be ascertained very gradually. Mr. Jackson, their managing director, was an electrical engineer, and was recommended to the company by Sir Wm. Preece, of whom he was formerly a pupil. One shareholder had remarked that he had been to the works at Canonbury and had not seen £18,000 of stock there. He (the chairman) could quite understand that, seeing there was only £6,000 worth of the stock at Canonbury, there being £12,000 worth at Coventry. He was prepared to give an undertaking that the accounts to March, 1903, if he remained chairman, should be in the hands of the shareholders before June 30th.

Mr. Jackson, replying to the complaint that the company's investments had been realised, said the present directors took office with that direct intention. Shareholders could not expect the directors to do anything with a business of this sort without working capital. They wanted a good deal more capital than they had at present. He would not desire to carry on the telephone business unless he was satisfied it could be made a success, but he believed it could be, for it had life in it. Although they had not their former investments, they had a business, and, given a little more time, the board would show it was worth something.

Mr. Lawson, in deference to the feeling of the meeting, withdrew his amendment, and the report and accounts were adopted amid applause.

In a subsequent statement the Chairman said the company had not yet felt anything like all the benefits which would be derived from the concentration of the work at one establishment, but the profits made in the first nine months of the current financial year were better than those for the corresponding period of the previous year. The business, however, could not be conducted to the best advantage unless its finances were placed on a sound basis, and the negotiations to which he had referred having been completed, the board were about to lay a proposal before the shareholders, but it was their intention to consult some of the larger shareholders on the matter before calling a special general meeting.

Smithfield Markets Electric Supply Co.

Mr. H. S. Leon presided last Friday over the meeting held at Winchester House, and in moving the adoption of the report (Elec. Rev., February 13th) he said that the amount spent on capital account during the year was £541. A new generating set was to be purchased, and this would further increase the capital indebtedness, although the board would charge the revenue account with a fair proportion of the cost. By means of this set they expected to decrease expenditure, even if they did not bring on more consumers by it. The board would not utilise its borrowing powers unless under more favourable circumstances than prevailed at present, so that the revenue must be responsible for any further addition to expenditure. The revenue account showed that the sale of current had increased by 14 per cent. over the previous year, while the costs had only gone up by 3½ per cent. This had been done by great care and judicious management and not by cheese-paring economies. The provisional order expenses had now disappeared for ever from the accounts. A reserve fund had been provided for the premium when the second debenture came to be redeemed; £1,000 more had been placed to depreciation, and that account now stood at £2,000; £2,000 had been put to the general reserve fund. A large proportion of this money was invested in the business, and saved borrowing at a high rate of interest. In regard to the future, there were certain contingencies which were perhaps speculative—such as the cold store, which they hoped by the end of the year to be supplying with electricity—and they must exercise great caution in dealing with their surplus cash. There was going to be a slight reduction of tariff, which might cause a small temporary loss, but they hoped it would ultimately be of material advantage. After expressing the board's indebtedness to the staff for their excellent work, Mr. Leon formally moved the adoption of the report.

This was seconded by Mr. Schenk, and, after a few remarks from shareholders, it was carried.

One of the Shareholders said he had heard that the board was entering into negotiations for the sale of the undertaking to the City of London Co., but the Chairman replied that the board was not aware of any negotiations between the company which they controlled and the City Co.

Mr. Schenk was re-elected a director, the resolution for a 2½ per cent. dividend on £60,000 ordinary shares was passed, and the retiring auditors re-elected.

Charing Cross and Strand Electricity Supply Corporation.

At the meeting of this company held on 11th inst., Mr. W. F. Fladgate said that the progress of the business in the past year had been thoroughly satisfactory. First, with regard to the West End undertaking, it was a great satisfaction to find that after nearly 12 years in the district they were still perceptibly going forward. In the past year they had added 34,364 lamps to those which they were supplying, making the total lamps supplied in the West End districts no fewer than 280,605. The increase had one other satisfactory factor about it, which was that it was 6,458 in excess of the number of lamps by which they increased their output last year. As they had always found, the largest increase was in the old district of St. Martin's, which accounted for 18,873 in the total; the Strand accounted for 12,347; and Holborn and St. Giles for 3,144. They had never been quite contented with the working of the St. Giles and Holborn districts, but at the same time they were important to them for the consolidation of this district. In the capital account there was one item to refer to, viz., £2,757 for the sale of old plant. That was a sale of plant in the old station at Maiden Lane which had become obsolete. Of course, the original cost was largely in excess of the sum named, but the difference was amply provided for in the reserves. With regard to the revenue account, the first item was that of coal. The average price per unit last year was ·84d., and the average cost this year was ·77d., which meant a saving of £2,406 on the whole of the business. The repairs had been heavy and very thorough. For some time past, having regard to the fact that they had been working day by day for the City and West End, the work on the mains and machines had been serious, and in the course of this year they thought it would be better to submit the greater part of their mains and works to a thorough overhaul. The total cost of repairs was £11,670, which was an increase of £5,683 over last year. They could have put this to a suspense account, but thought it better to pay it out of the revenue of the year. There had been an increase in salaries of £2,000, and taxation accounted for an increase of £900. They had placed £10,000 to depreciation, which was £1,000 more than last year, and the result was that they had a balance of net revenue of £41,135 8s. 3d. This was not as satisfactory as last year, because then, with a sale of less current, they brought in the same amount. He had, however, explained the chief items of increase, and there was another item which had to be considered; it was that there had been a large sale in bulk to the City undertaking, which amounted to £8,162, and this did not bring so large a profit as that sold to outside consumers. In the balance-sheet there were two items to which he would call attention. The first was £300,000 in investments at cost in the Charing Cross and City Electric Co. That was a temporary investment, and was more than amply secured. When the accounts between the two companies were made up, this £300,000 of debentures would be dealt with. The next item was £200,000 ordinary shares, and as they knew, the acquisition of these shares was the culminating point in the arrangement with the City Co. for which he was responsible, so that the Charing Cross shareholders should have secured to them the whole of the surplus profits on the City undertaking whatever they might be. The fact was that the whole of the ordinary shares in the City Co. were held by the Charing Cross Co., and he had great hopes that a good return would come from them to swell the profits of the Charing Cross shareholders. They were paying a dividend of 10 per cent., and carrying forward £14,800, and they had provided for the guarantee on the preference shares of the City Co. In the current year he had every confidence that the City Co. would itself earn the preference dividend. Last year he ventured to prophesy that the number of lamps supplied in the City would be 150,000, but, as a matter of fact, on December 31st they had supplied 150,759, and they were now supplying 156,435. It took them eight years in the West-end to supply 150,000 lamps, and they had reached that number in the City in the course of two years. It had not been done, however, without a large outlay, for they had carried out their policy of tackling the question in a business-like way, and had supplied electricity at a price satisfactory both to the consumers and to themselves. They were already making a profit in their trade dealings in the City. They had not failed to expend money to secure efficiency, and he believed their station and plant was equal, if not superior, to any other company. Neither in the City nor in the West-end was their work finished. In the City they had a site, and were going to build a station for the supply of the northern area, and in the West-end they had been strengthening their mains and stations, and were now in a position to give public buildings and theatres and hospitals two independent sources of energy.

Mr. G. H. B. Glasier seconded the motion, and the report was adopted.

Cambridge Electric Supply Co.

Mr. D. Munsey presided at the meeting held on 11th inst., and in moving the adoption of the report, which has already appeared in our columns, he said that they had added 3,833 new lamps during the year, and had supplied 50,000 more units than in the previous year, and these facts had compelled them to carefully consider what must be done to meet the growing demand.

Mr. A. A. C. Swinton seconded the motion, and he said in the course of his remarks, that he had seen it mentioned that they paid too much money to depreciation, but it was most important, with critical electrical machinery, which rapidly became antiquated, that there should be a sufficient sum put aside every year so that everything might be kept up-to-date. He would like to point out that not only was everything going on satisfactorily, but they were steadily saving. For instance, the coal this year per unit sold had cost less than it did the year before. Practically every item, such as labour, repairs, and other necessary expenses, was less this year than in the year before, with the result that the cost of producing the electricity at the works this year was 2·3d., as against 2·58d. In regard to the question of the removal of the works from their present position, when the company was started he did not think anybody had an idea how rapidly an electric undertaking of that kind was going to grow. The directors had come to the conclusion that in the interests of the shareholders, as well as the consumers, it was practically necessary that a new generating station should be built. A town like Cambridge would not support two generating stations, and it was proposed to move from the present site

altogether. They had spent a very large amount in investigating throughout the town in order to ascertain where the station could best be situated. Unfortunately, there was no place in the town which was really suitable. They had purchased a piece of ground outside the borough where the G.E. Railway crossed the Cam with the idea of moving the station to it. They had come to the conclusion that for the supply of Cambridge itself it would be necessary sooner or later to move the generating station, and they were of opinion that the longer it was put off the greater would be the expense. They also thought the matter of extended area was a very good thing, but in the first instance they were only going to supply just in the neighbourhood of Cambridge, where it would be remunerative. They had taken a large area because the town was growing outside its present boundaries, and because in applying for a provisional order they had to define the area. The Board of Trade also preferred the definition to be by means of parishes, and, therefore, they had taken parishes.

The motion was carried.

Prospectuses.

The British Electric Transformer Co. (1903), Ltd., has been before the public this week offering 50,000 6 per cent. preference shares, and 15,000 ordinary—all £1 shares—at par. The company has a nominal capital of £125,000, and it takes over the business of the British Electric Transformer Manufacturing Co., Ltd., of Hayes, Middlesex, whose Berry patent transformers are well known, and their merits appreciated by all electrical power-station engineers. The purchase price fixed by the vendor company is £60,000, all payable in ordinary shares. The works and plant are valued at £10,543. We note that in the statement of the assets of the vendor company, patents stand at £25,944. The company did well last year, its net profits being £10,004 (before deducting directors' fees), and the business is steadily increasing. The outlook for the company is very promising, and its shares strike one as being a good thing. The list of applications was to close yesterday (Thursday) afternoon.

The British Columbia Electric Railway Co. has this week been offering for subscription £175,000—4½ per cent. Vancouver Power debentures of £100 for the purpose of acquiring the bulk of the share capital of the Vancouver Power Co. at par. The list closed on Wednesday.

Stock Exchange Notice.—The Committee has been asked to allow the following to be quoted in the Official List:—Western Telegraph Co., Ltd.—Further issue of £118,945 4 per cent. debenture stock (redeemable).

Walter Scott, Ltd.—Interim dividends for the half-year ended December 31st, 1902, at the rate of 6 per cent. per annum upon the cumulative preference shares, and at the rate of 5 per cent. per annum upon the ordinary shares.

Chelsea Electricity Supply Co.—The directors have declared a dividend at the rate of 6 per cent. per annum on the ordinary shares, making 4½ per cent. for the year, carrying forward £300.

W. T. Henley's Telegraph Works Co.—Subject to audit, the directors recommend payment on March 2nd next of a dividend on the ordinary shares for the past year of 20 per cent., including the interim dividend of 6 per cent. already paid.

National Electric Supply Co.—At the annual meeting held at Preston, Mr. J. Y. Booth said the gross profit for the year was £11,125, as against £8,848 in 1901. Out of this £2,300 was placed to the depreciation fund. Dividends of 4 per cent. for the year on the preference shares, and 5s. 6d. on the ordinary shares for the half-year, making with the interim dividend paid in July, 8s. per share for the year, were declared, in addition to a dividend of £2 14s. 3d. on the founder shares.

STOCKS AND SHARES.

Wednesday Evening.

The King's speech at the opening of Parliament has affected Consols and similar securities less than the growing demand for money. Moreover, the funds continue dull by reason of the fear that investors will sell their Consols when the reduction in the interest takes place. For once in a way, the general investment markets, however, are moving on pivots of their own, more or less regardless of the purely gilt-edged departments. Railway securities have hardened considerably, the comparatively high yield that can now be obtained tempting buyers. Telegraph descriptions continue to improve, despite the honours showered on Signor Marconi, and in the electricity supply section the tendency is also towards higher values.

From the statements made by Mr. R. W. Perks, M.P., at Tuesday's meeting of the Metropolitan District Railway, it would appear that the recently raised hopes of amalgamation between the two underground companies are decidedly premature, and the militant tone of the speaker brought about a prompt fall in the prices of both Metropolitan District and Metropolitan Consolidated stocks, the former being the most affected. There is a rumour on foot to the effect that the District Co. is about to make a fresh issue of capital, and the revival of the scheme for joining Hammersmith with the north and east of London is exercising the mind of the market as to whether any advantage is likely to accrue therefrom to the other underground concerns.

Central London stocks have not yet recovered the dividend deductions made on the last Stock Exchange pay-day, and the controversies that rage around the question of Tube ventilation are causing some people to hold aloof from investment in the company's stocks. City and South London Ordinary easily regained the dividend deduction, although the best prices of the week have not been maintained, and the stock is back to 78. "A little healthy reaction" is the reason given by some of the dealers for the trifling set back that has occurred; Waterloo and City stock *ex* 1⅝ per cent., shows no change in quotation.

The Taff Vale Railway is one of the latest converts to the use of electric traction, and the board is about to experiment with the new system over part of the line. At present the stock is quoted at 73. North-Eastern Consols are now 150, and perhaps the great carrier of the North of England has suffered more than any other from the effects of light railway competition. It is stated that the London and South-Western has come to a working agreement with the London United Tramways Co., but the announcement has had no effect upon the securities of either concern. London United Preference shares are 11½, and the Debenture stock 106. A good deal of business was doing in Perth (W.A.) Electric Tramways 5 per cent. Debenture stock, the price being about 103½. Calcutta Trams changed hands the other day at 7¼; the Buenos Ayres and Belgrano issues are without change. British Electric Traction Ordinary remain in demand, and the price has advanced ¼, while the Preference, *ex* 6s. dividend, are marked down to the same extent as the Ordinary have risen.

Telegraph issues, as noted above, have still further improved, and again Eastern Ordinary comes out on top of the list with a jump of 6 points, although Eastern Extension shares are unaltered at 12. A jerky market in these stocks and shares would appear almost inevitable for some time to come, but on balance, the probabilities are that prices will gradually harden. The Anglo-American Co.'s trio has spurted sharply, but the other American shares fail to follow its lead. Cuba Telegraph are up another £1, making £1 10s. in the fortnight, and all in the West India and Panama series have shot up. For these movements the traffic caused by the Venezuelan affair must be thanked. Of course, the narrowness of the market in telegraph issues goes far to explain the apparently violent fluctuations, for as a rule the dealers are either all buyers or all sellers, and consequently prices are moved in a manner out of any proportion to the amount of business that causes the variations. Globe Telegraph and Trust shares are up ½ in both cases, thanks to the revival in the general market. Submarine Cables Trust certificates keep dull in consonance with the quietude of the Yankee railroad section. Marconi shares, about 3¼, are dealt in by the Kaffir circus as well as the miscellaneous market of the Stock Exchange.

In the electrical supply division the feature of the week is a rise of a sovereign in Chelsea Ordinary shares, County of London following with an improvement of half that amount. The Chelsea buoyancy is difficult to explain, and some think that the buying which has caused it is actuated by at present unknown influences. Metropolitans keep steady at 19, which is ½ up, notwithstanding the wrathful storms which have arisen and are raging in Marylebone with reference to the award of the arbitrator. Local feeling runs high on the subject, but it seems clear enough that the money will have to be paid, and the company has already claimed interest on the amount from the time that the award was given to the date when the cash shall be handed over. The company's Debenture stock is a point to the good, and a corresponding rise has carried London Electric Debenture over par, the shares being also better at 2½. Several of the securities in this section are now marked *ex* dividend, with little change to the quotations as a rule.

Stimulated by the appearance of the National Telephone report, the company's Preferred stock and Third Preference shares have hardened slightly, while the Deferred exhibits no alteration. The Miscellaneous list is somewhat colourless, but Telegraph Constructions stand out with a rise of a £1.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Feb. 11th.	Closing Quotations Feb. 18th.	Business done week ended Feb. 18th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	96 —100	96 —100	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛ — 3⅛	2⅛ — 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3⅛%	6⅛%	60/6	47 — 50	49 — 52 xd	50	49
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	92 — 94 xd	93½	89⅞
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	7⅞ — 8⅛	8¼ — 8⅜ xd	8⅜	8⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4 — 4½	4 — 4½	4⅜	4½
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —180	160 —170	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	90 — 93	92½	91½
16,000	Cuba Telegraph	10	4½%	4 %	..	5½ — 6⅛	6½ — 7⅛	6⅝	5⅝
6,000	Do. 10 % Pref.	10	..	..	..	13 — 14	13 — 14	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	7	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10¼ — 11	10 — 10⅝	10⅛	10⅛
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —102	98⅜	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	117 —122	123 —128	126½	119
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	85 — 88	86 — 89	87	85¼
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	105	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	11¼ — 12½	10¾ — 11¾	12⅜	11⅜
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	107 —110	106	105
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8⅜ — 8⅝	8⅜ — 9⅛	9⅛	8⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	11¼ — 12¼	12 — 13	12 7/8	12
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	..	25 — 27	25 — 27	26⅜	26¼
66,300£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	..	37 — 41	37 — 41	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	2½%	..	⅛ — ¼	⅛ — ¼	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	..	..	..	¾ — 1	¾ — 1	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	97 — 99	98 —100	99½	97
1,966,667	Do. do. Def. Stock	100	..	..	4½%	70 — 72	70 — 72	71⅛	70
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅜	12 1/16
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜ — 5⅛	5 — 5⅛	5 1/16	..
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 97	95 — 97	96	95⅝
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅜	102⅛
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	¾ — 1	¾ — 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½ — 7½	6½ — 7½	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	105 —115	110 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5⅛ — 5⅜	5⅛ — 5⅜	5 9/16	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅛ — 5⅛	4⅛ — 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	96 — 99	96 — 99	97⅞	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	10¾ — 11¼	10 — 11	11 1/16	10 7/8
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	97 —100	100	98½
88,321	West India and Panama Telegraph	10	½%	..	..	⅛ — ⅜	⅛ — ¼	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	4⅞ — 5¼	5⅛ — 5¼	5¼	5⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	2¼ — 3¼	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	76	75½
100,000	British Electric Traction	10	9 %	9 %	..	13 — 13⅜	13¼ — 13⅝	13⅜	13⅜
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12¼ — 12½	12 — 12⅜ xd	12⅜	12⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	124 —127	126	125½
100,000	British Insulated Wire Ord.	5	15 %	10 %	..	7⅜ — 8	7⅜ — 8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝ — 6	5⅝ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	12/6 to 13/6	12/6 to 13/6	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	16/6 to 17s.	16/6 to 17s.	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	..	¾ — 1¼	¾ — 1¼	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	..	1 — 1⅜	1 — 1⅜	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	91 — 96	91 — 96	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	..	14 — 15	14 — 15	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅝ — 6	5⅝ — 6	5⅝	5 11/16
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	108 —111	106 —109 xd	108	107½
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	105 —108	103 —106 xd	105½	105
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	113 —116	109 —113 xd	110½	..
1,330,000	City and South London Railway	Stock	1¼%	2 %	3⅛%	76¼ — 77½	77⅜ — 78⅝	80	77½
85,000	Crompton & Co., Nos. 1 to 85,000	5	8 %	7½%	..	2¼ — 3	2¼ — 3	2½	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1⅝ — 2⅛	1⅝ — 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	74½	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅛ — 2	1⅛ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	2 1/16	..
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	100 —103	100 —103	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15⅜ — 16⅛	15⅜ — 16⅛	15⅝	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5⅛ — 5⅝	5⅛ — 5⅝	5⅜	5⅛
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —113	109 —113	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½ — 19½	18¼ — 19¼	19⅛	18⅜
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	101 —104	101 —104	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	1½%	1½%	5⅞ — 6	5⅞ — 6⅛	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10⅜ — 11	10⅜ — 11	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14¼ — 15½	14⅜ — 15⅜	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	37 — 40	38 — 41	39½	38
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3⅛%	97 —100	97 —100	..	..

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.
‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅞—⅞.
National Electric Free Wiring, ¾—1.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref. (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Feb. 11th.	Closing Quotations Feb. 18th.	Business done week ended Feb. 18th, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	‡ 1	..	..	..	⅛ — ¼	⅛ — ¼	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	114 —117	114 —117	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10⅜ — 10⅝	10⅜ — 10⅝	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10 — 10¼	10 — 10¼	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9⅛ — 10	9 — 9⅛ xd	9⅛	9
70,000	Do. do. 4½% Cum. Pref.	5	..	..	..	5⅛ — 6	5⅛ — 5⅜ xd	5⅜	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4½ — 5⅛	4½ — 5⅛	4⅝	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	104½	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5 — 5⅛	6 — 6¼	6⅛	6¼
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	109	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10 — 11	10 — 11	10⅛	10⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13½ — 14½	13½ — 14½	14½	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	123	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	..	8¾ — 9½	9 — 10	9⅝	9½
20,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	..	..	12 — 13	12 — 13	12¾	..
400,000	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	108 —111	108 —111	110¾	109
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6½ — 7	6½ — 7 xd	6¾	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6¼	6⅜	6¼
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	106 —109	106 —109	108	106½
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½ — 11¼	10½ — 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	100 —103	100 —103	..	..
110,000	ondon Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞ — 2⅛	2 — 2¼	2⅛	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5¼ — 5⅝	5¼ — 6	5⅜	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	97 —100	98 —101	100	99½
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¼%	..	18 — 19	18½ — 19½	18⅝	18½
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	107 —112	108 —113	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	..	14⅜ — 15¼	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅜%	14⅜%	14⅜%	14⅜ — 15⅜	14 — 15	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	..	8¾ — 9¼	8¾ — 9¼ xd	..	..
150,000	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	2½ — 3	2 — 2¼	..	..
50,000	Do. do. 4% Deb.	100	..	..	..	85 — 90	80 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3⅛ — 3⅜	3⅛ — 3⅜	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅝ — 5⅛	4⅝ — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12¹¹⁄₁₆	12⅝
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6⅛	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, February 18th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	£33 10	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23 15	£23 15	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	119/-	119/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b ,, Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£42 to £140	£40 to £130	inc.
c Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	6¼d.	..
c ,, Tube (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	7d.	7d	..
c ,, Wire, basis	per lb.	6¾d.	6¾d.	..
c Copper Tubes (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	9d.	9d.	..
g Copper Bars (best selected	per ton	£71	£71	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£71	..
g ,, Rod	per ton	£71	£71	..
e ,, (Electrolytic) Bars	per ton	£60	£60	..
e ,, ,, Sheets	per ton	£74	£74	..
e ,, ,, Rod	per ton	£63	£63	..
e ,, ,, H.C. Wire	per lb.	7¾d.	7¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/4½	1/4½	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/5½ to 3/6½	3/5½ to 3/6½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	47/8	47/8½	4½d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£12 5 to £12 10	£11 15	10/- to 15/- inc.
g ,, ,, Sheet	per ton	£18	£18	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 12 6	£8 12 6	..
d Mica (in ginal cases) small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2	11¾d. to 1/2	inc.
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars	per ton	From £15 to £40	From £15 to £40	..
g Tin, Block	per ton	£134 10 to £135 10	£134 to £135	10/- inc.
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1,9	1/7½	1½d. inc.
p White Anti-friction Metals— "White Ant" brand	per ton	£38 to £60	£36 to £60	inc.
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4⅛d.	4⅛d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 10	£23 10	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons., Ltd. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Edward Till & Co. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Co. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company Ltd.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
Blackburn Corp. Trys.	Feb. 13	£ 69	£ +151	£ 97,025	£ + 4,586	12½	12½
Blackpool and Fleetwood	,, 14	189	+ 51	4,203	+ 182	7¾	7¾
Bristol Trys. & Car. Co.	,, 13	4,822	+642	—	—	28	28
British Elec. Trac. Co.:—							
Barnsley District	,, 6	156	—	790	—	—	—
Devonport	,, 6	386	+ 46	1,978	— 195	5	5
Dudley—Stourbridge	,, 6	679	+ 98	9,453	+ 230	12¾	10¾
Gateshead	,, 6	814	+125	4,192	+ 844	10½	9½
Gravesend—Northfleet	,, 6	171	—	875	—	3½	3½
Greenock—Pt. Glasgow	,, 6	409	+ 51	2,063	+ 167	7¾	7¾
Hartlepool	,, 6	210	+ 59	1,084	+ 184	6½	4½
Kidderminster	,, 6	93	+ 12	504	+ 94	4½	4½
Merthyr	,, 6	171	— 9	843	— 134	3	3
Middleton	,, 6	199	—	1,188	—	8½	—
Oldham—Ashton	,, 6	499	+ 56	2,656	+ 150	8	8
Peterborough	,, 6	150	—	825	—	—	—
Poole	,, 6	257	+ 77	1,138	+ 206	9½	8½
Potteries	,, 6	1,492	+186	7,695	+ 540	29½	29½
Rotherham	,, 6	40	+ 14	219	+ 56	—	—

* Compared with the corresponding period of 1901.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
B.E.T. Co. (*continued*)—		£	£	£	£		
Southport	Feb. 6	206	+ 94	1,079	+ 444	5½	5½
South Staffordshire	,, 6	685	+ 15	3,388	— 328	21½	22½
Swansea	,, 6	448	+103	2,281	+ 177	5½	6½
Taunton	,, 6	48	+ 0	247	— 23	1½	—
Tynemouth	,, 6	202	+ 32	1,080	+ 53	3½	3½
Weston-super-Mare	,, 4	27	—	115	—	2½	—
Wolverhampton Dist.	,, 6	334	+107	1,685	+ 944	10½	2½
Central London Railway	,, 14	6,926	+195	48,640	+ 2,493	6	6
City and S. London Ry.	,, 15	2,107	— 37	23,313	+ 2,001	6½	6½
Doncaster Corp. Trys.	—	—	—	—	—	5½	—
Dover Corporation Trys.	,, 14	172	+ 23	1,113	— 10	3	3
Dublin United Trys.	,, 13	4,419	+793	26,600	+ 1,388	46	46
East Ham Tramways	,, 14	514	+218	16,681	+ 3,988	5	4½
Glasgow Corp. Trys.	Jan. 24	11,629	+999	415,909	+ 2,501	62	50½
Liverpool Overhead Ry.	Feb. 15	1,482	+148	10,391	+ 945	6½	6½
Newcastle Corp. Trys.	,, 14	3,055	—	—	—	35	—
Sunderland Corp. Trys.	,, 15	1,011	+118	—	—	17½	17½

HIGH-SPEED BEARINGS.

Considering that modern electrical machinery often involves heavily-loaded bearings running at a high surface speed, and that such bearings must often be shorter than, perhaps, the designer would desire if more free to design as he wished, Herr O. Lasche, of Berlin, has written an article on certain experiments made with a view to elucidate the influence of the above factors, and to point out how designers should design with a view to a proper compromise between circumferential speed and unit pressure. He says bearings should be short, presumably because he supposes that a long bearing cannot be a well-fitted one.

The authoritative experiments of the past were those of Tower, Thurston and Woodbury, but they did not embrace conditions now common. In the present article, diagrams in three dimensions have been employed, showing circumferential velocity in metre seconds $= v$; pressure on the journal in kilogrammes per square centimetre $= p$; and temperature in degrees C. $= t$.

Thurston's experiments were carried out between 0·15 and 6 m. per second, and at a pressure $p = 0{\cdot}28$ to 14, and in special cases 70, and $t = 30°$ C. to 80° C. Woodbury's experiments included $v = 1{\cdot}5$; $p = {\cdot}07$ to 2·8; and $t = 2°$ C. to 38° C. Tower's experiments included $v = 0{\cdot}5$ to 2·5, $p = 7$ to 44, and $t = 15°$ C. to 50° C. Thurston used a heavily weighted pendulum swung on a revolving journal, the angle of deviation from the perpendicular giving a measure of the friction. Tower used an arrangement like a Prony brake, and Woodbury employed a weighted revolving disc on a vertical spindle, one disc or ring plate revolving on another, which it tried to drag after it, the drag being measured by a balance, and the device being scarcely suitable for determining the friction of horizontal axles.

According to Tower, the coefficient of friction μ depends on v and t, increasing with increase of v, and this is confirmed by the Allgemeine E.G. tests now recorded by the author. Thurston found that for p less than 7, μ did not vary when t varied, but when p went over 7, μ increased rapidly with increase of t. This applies only to low values of v. When p is heavy and v is low, oil does not get drawn in well. Woodbury and Tower found that μ decreased as t increased.

But all the experiments are of no value for determining modern bearings, where $v = 10$, 20 or 30 and $p = 10$ and 15.

Herr Lasche's tests were made on two apparatus. In one, a journal 260 × 110 mm. long was employed; in the other the bearing had a diameter of 110 and a length of 240 mm. The friction was measured first by a balance which weighed the drag, and afterwards by measuring the heat generated. The bearings were pulled up against the journal so that the lower bush was the one under pressure, and the shaft was motor-driven. The journal was of nickel steel.

The points sought were the effect on the coefficient of friction of the pressure; the velocity of rubbing; the temperature of the rubbing surfaces; the material of the journal and bushes and the lubricant; the manner of effecting the lubrication as regards oil grooves, &c.; the influence of play; friction work; cooling by radiation and by oil.

With nickel steel and white metal bush and $v = 10$, the total friction R is dependent on total pressure P and on t. Thus for $t = 50°$ C. and P = 500, 1,000, 2,000, and 2,850 kg., R = 7·35, 8·35, 8·35 and 8·35 kg., and when t was raised to 100° C., R became 4·06, 4·8, 5 and 5 kg.

To determine the coefficient of friction μ, various bearings were tried:—Gun-metal, white metal, mercury amalgam with nickel steel journal, and white metal with mild steel journal, the journals being 260 × 110 mm. long. With journal 110 × 240 mm. long, white metal bushes were tried.

The lubricants were Imperial oil No. 0; a Russian mineral; rape and sperm. These were supplied at the rate of 1·4 pints per minute from an overhead reservoir, and the oil was warmed or cooled to the desired temperature at which the journal was to run. In all cases p was measured on the horizontal projection in plan of the journal in square centimetres.

μ was found (*a*) at $v = 10$ for p and for t; (*b*) for v and t for $p = 6{\cdot}5$; and (*c*) for p and v for $t = 50°$ C.

For (*a*) the coefficient of friction μ decreases at first rapidly, then slowly, as p increases; with t = constant, p varying from 1 to 15, μ decreases for any materials as p increases, and as found by Tower. μ is inversely as the pressure per unit area, and for $v = 10$ and $t = 50°$ C., $p \times \mu = 0{\cdot}04$ kilogramme per square cm.

Hence for any total load P, the total friction increases with the surface, whether obtained by length or by diameter, a conclusion opposed to practice, which demands long journals for high speeds, probably, it is suggested, to cover the effects of vibration.

For $p = 6{\cdot}5$ and $t = 50°$ C., μ first increases with v and then decreases, increasing up to $v = 10$ to 15, and then slightly falling.

Thurston found μ varied as $\sqrt[5]{v}$, up to $v = 6$. Bache deduced from Tower's experiments that μ varied as $\sqrt[3]{v}$ up to $v = 2{\cdot}4$. Stribeck practically confirms both these findings within their own range, and that at higher speeds v ceases to have influence, and for $v = 8$, μ is little above its value for $v = 4$. Hence for v greater than 10, μ is independent of v.

As regards temperature, for $v = 10$ and $p = 6{\cdot}5$ μ decreases as t increases, as found by Tower, from 40° to 100°; for $t = 50°$ C. and $p = 6{\cdot}5$, $\mu = {\cdot}00615$. Hence $\mu \times t$ = constant and for $p = 6{\cdot}5$ it is 0·3 independent of v. For t = constant and v optional $p \times \mu$ = constant, and for $t = 50°$ C., $p \times \mu = 0{\cdot}04$; by combination $p \times \mu \times t$ = constant = 2 within the limits of $p = 15$, $t = 100°$ C. and $v = 20$.

The material forming the journal appears to be of no marked importance frictionally. For $v = 10$, $t = 50°$ C. and $p = 1$ to 15, $\mu = 0{\cdot}008$ for ordinary and mild steel and 0·006 for nickel steel. As regards bearing material, for $v = 10$, $t = 50°$ C. and $p = 6{\cdot}5$, μ is 50 to 79 per cent. greater for mercury amalgam than for gun-metal.

The different oils appeared only to differ at low temperatures. The means of applying oil must be suitable to the conditions, a non-pulsating bearing demanding more positive means than one which, in a sense, pumps in its oil.

Thus crankpins up to $p = 100$ and crankshafts up to $p = 30$ still run with mere drop lubrication, but for bearings under steady load or at high speed, forced lubrication is indispensable even for low pressures. Much, of course, depends on the frictional work per unit of time, for if much heat is developed it can only get away by radiation, conduction, or by being carried off by the oil, which will often do this better than it can be done by water jacket.

As regards oil grooves, it is recommended that these should start where the oil is delivered as by ring lubrication, and oil grooves should not have sharp edges, or they will wipe off the oil. Grooves must not extend right along a bearing or they are apt to drain it, but should return in an opposite spiral and carry back oil over the bearing surface. Closely-fitted journals require forced lubrication, and such require a good deal of power to turn them.

THE JOHANNESBURG ELECTRICAL SCHEME.

Our readers are aware that some months ago Messrs. Mordey and Dawbarn, of Westminster, were engaged to report upon the question of electric lighting, power and tramways in Johannesburg, and as we intimated in our last issue the Corporation adopted the scheme drawn up by them at its meeting on January 12th. The total capital expenditure involved is £1,290,000, and in the following notes we are able to indicate the character of the proposals and the different items of expenditure.

It may first of all be of interest to state the terms of the consulting engineers' engagement. For their visit to Johannesburg, including the preparation of the scheme with reports, plans and estimates, they are to have a fee of 2,500 guineas, plus expenses. This fee merges into the later commission charges for carrying out the work, and we are informed that the total fees are estimated to amount to £20,000 by the time the works are completed. Messrs. Mordey and Dawbarn are now proceeding with the preparation of detailed plans and specifications.

The estimates make provision for 27·67 miles of route in all, and for a power station calculated on the same scale. The following table will show what the proposals are at a glance:—

Section A.—Electric Light and Power.

Generating Station Equipment—

Three 2,000-B.H.P. gas engines, coupled to three 1,250-KW. dynamos	£54,060
Three 1,000-B.H.P. gas engines, coupled to three 675-KW. alternators with exciters	27,540
Switchboards, motor balancers, and electrical engine room accessories	13,630
Producer gas generators for 6,075 KW.	25,200
Cooling towers, pipework, and electrical connections inside station	18,475
Coal and ash conveyors, bunkers, engine room travelling crane, tools and accessories	12,060
Erection of the above plant on site and expenses in setting to work, 10 per cent.	15,095
Allow for generating station buildings, including clearing ground, foundations for all machinery, trenches, offices, meter-testing room, workshops, mess rooms, and all furnishing, lighting, &c., required, with space for two additional 2,000-B.H.P. engines and dynamos, all complete, including cost of all materials delivered to site, and erection complete	74,520
Freight, insurance, dock dues, railway rates, and clearing charges, 4,930 tons at £9	44,370
Transit duty, 3 per cent. on £150,965	4,530
Fees and contingencies, 10 per cent.	28,950

Cables, &c.— *Inner Area.*

One 45,900 yds. (route) of distributing cables, three-wire direct current system with all necessary feeders laid complete in trenches	33,552
Troughing, junction boxes, and road trenching for ditto	18,908
House service connections and meters, say 800 consumers, at £8	6,400

Outer Area.

108,580 yds. (route) of overhead distribution cables (bare low pressure), erected complete, existing poles, in "Inner Area," being transferred to "Outer Area"	£15,309
High-pressure feeders for ditto, laid complete in trenches	9,578
1,320-KW. transformers at £2·25	2,970
Troughing, junction boxes and road trenching	8,741
House service connections and meters, say 1,600 at £8	12,800
Housing for transformers, 28 at £200	5,600

Street Lighting.

Underground street lighting cables for Inner Area	2,670
110 arc lamps and posts for ditto, at £40	4,400
450 glows, adapting existing gas posts, at 30s.	675
Overhead street lighting cables for Outer Area	675
1,000 existing lamps, adapting, at £1	1,000
1,400 new street lamp fittings and fixing to poles for overhead cables, at £3	4,200
Freight, carriage insurance, import duty, &c., 25 per cent. on £99,000	24,750
Fees and contingencies, 10 per cent.	15,222
	£485,880

SECTION B.—ELECTRIC TRAMWAYS.

Generating Station Equipment—

One 2,000-B.H.P. gas engine and dynamo	£18,020
One 1,000 " " "	9,180
Switchboards for above	2,025
Producer gas generators	5,670
Additional pipe work, cooling tower and electrical connections, &c.	4,878
Coal and ash conveyors and tools (additional)	4,878
Erection of the above plants and expenses in setting to work	4,614
Generating station buildings and foundations (additional)	16,402

Track for 11·96 miles of route adopted by Committee, December 31st, 1902—

23·92 miles of 93-lb. grooved rails with points, crossings, tie bars and special lay-out work at manufacturers, at per mile £1,562	37,363
23·92 miles of concrete bed 580 cb. yds. per mile = 13,874 cb. yds. laid complete at 52s. per cb. yd.	36,072
23·92 miles excavating road for concrete bed, plate laying, cartage, parging and electrical bonding, at £1,013 per mile	24,231
Provision for paving (edging each side of each rail with one row granite setts when required)	20,000
11·96 miles of overhead construction, at per route mile £1,500	17,940

Cables (corresponding to above 11·96 route miles)—

Underground feeders	7,732
Feeder pillars	225
Troughing and trenching roads	3,339

Cars (corresponding to above 11·96 route miles)—

75 cars, at £600 each	45,000
Buildings for car sheds on lighting works site	22,500
Car shed equipment	2,862
Re-erection of cars on site, 75 at £25 each	1,875
Tools additional to lighting works	2,000

Freight, Insurance and Dock Dues, Railway Rates and Clearing Charges—

1,550 tons of machinery, at £9 per ton	13,950
3,830 do. rails, &c., at £7·75 do.	29,682
700 do. poles, at £7·75 do.	5,425
750 do. cars, at £9 do.	6,750
Duty (transit), 3 per cent. on £150,000	4,500
Do. (import), 10 per cent. on £35,000	3,500
Cables, 25 per cent. on £7,732	1,933
Fees, contingencies, &c., 10 per cent.	37,168
	£389,714

SECTION C.—TRAMWAYS—PROVISION FOR EXTENSIONS.

Track—

6·18 route miles double track = 12·36 miles single track on concrete with all accessories, at per mile, £4,083	£50,465
6·19 route miles double track and 3·34 route miles single track = 15·72 miles single track on sleepers, with all accessories, at per mile, £2,686	42,224
15·71 route miles = 28·08 track miles.	
18·47 route miles overhead electric construction, at per mile, £1,500	27,705
Ballasting, banking and draining for sleeper construction	12,000

Cables—

Underground and overhead feeder cables and pillars, laid complete	£9,158

Cars—

Forty cars (additional) on site	25,000
Buildings and land for ditto (additional)	12,000
Car shed equipment	1,520

Freight, Insurance, &c.

Freight, &c., on above	38,000
Fees and contingencies, 10 per cent.	19,824
	£237,896

SECTION D.—GAS CONVERSION TO PRODUCER GAS.

Additional producer plant and accessories	£657
Freight, carriage, duty, &c.	137
Fees and contingencies—10 per cent.	72
	£873

SUMMARY OF CAPITAL OUTLAY ESTIMATES.

(*a*) Electric light and power	£485,880
(*b*) Electric tramways	389,714
(*c*) Electric tramway extensions (provision for)	237,896
(*d*) Gas conversion	873
Generating station site	17,000
Allowance to consumers per alteration	7,700
Provision for special contingencies	100,937
	£1,240,000

[In a later note it is recommended that an additional £50,000 be allowed for contingencies, thus making up the total £1,290,000 as stated above.]

The public supply of electricity in Johannesburg at the present time is municipal, and the demands are met from two sources:—

(*a*) From the Council's generating station in President Street, and

(*b*) By purchase in bulk from the Rand Central Electric Co. at a transforming station in Berea Street.

These together produce a maximum of about 1,200 KW.

The generating station for the latter supply is situated at Brakpan, some 18 miles or so distant. The Rand Central Electric Co. is under contract to give additional supply of 200 KW. at the end of this year, which will make a maximum load from each station of about 700 KW., or nearly 1,900 B.H.P. in all.

There are three distinct systems of supply from the municipal station, viz.:—

(1) Street lighting by arc lamps in series—direct current, 1,000 volts.

(2) Supply to private consumers—single-phase alternate current with transformers on consumers' premises, reducing the pressure from 2,000 to 100 volts. The periodicity is 60.

(3) Supply to private consumers—three-phase alternate current, with transformers on consumers' premises, reducing the pressure from 2,000 to 100 volts on each phase. The periodicity is 50.

The latter only is available in the daytime, the day supply being, however, confined to the one existing underground main which supplies the General Post Office and a few buildings in its immediate vicinity.

The supply from Brakpan is on the three-phase alternate current system, at a pressure of 2,000 volts, transformed at Berea Street from the company's 10,000-volt mains. Transformation from 2,000 to 120 volts takes place in sub-station kiosks in the streets, and not on consumers' premises.

With the trifling exception above mentioned, the whole of the conductors of all the systems are overhead.

The present municipal station is so fully loaded that there is no reserve for emergencies. For a long time past all new applications for connections to the mains have had to be refused.

The total number of units sold from the two sources, apart from street lighting, is now at the rate of 1,577,000 units per annum. The average price obtained from all private consumers—of which there are 1,231—is about 9d. per unit, representing a gross revenue of about £60,000 per annum.

The return for the last six months shows the following:—

Units generated in municipal station, plus the units bought from Brakpan	789,107
Units sold	602,371
Units unaccounted for	186,736

The proportion of lost units, viz., 23·6 per cent., is very high.

The cost of production and distribution from the municipal station averages 6·68d. per unit sold, and from the Brakpan supply 6·29d. per unit sold.

The consumption for arc and incandescent street lighting from both sources of supply is about 218,480 units per annum, which, at the basis charge of 6d. per unit, amounts to £5,462. Adding a maintenance allowance of £1,000 per annum, this gives a revenue of £6,462 for electric street lighting.

The engineers estimate that the street lighting from the municipal station costs about 4d. per unit; that supplied from Brakpan about 6d. per unit.

The street lighting by gas adds a further £5,916, representing a total of £12,378 per annum as the present cost of the street lighting.

The plant in the municipal generating station consists of units which are very small in relation to the demand for electric energy in Johannesburg. There are no less than 16 dynamos in use for the combined public and private lighting, having a total capacity of only 800 KW., an average of only 50 KW. per dynamo. These dynamos are, moreover, of three distinct types which are not reserves for one another.

Messrs. Mordey & Dawbarn recommend that in re-organising the undertaking this apparatus be entirely discarded, as on the ground of smallness alone, it is quite unsuitable, apart from any questions of type.

The gas works, which are also municipal, are on the same site as the electricity generating station.

The existing tramways are owned by the Johannesburg City and Suburban Tramway Co., Ltd., and are worked by horses. The gauge is 3 ft. 6 in. The lines extend over about 8¾ miles of route, partly single and partly double track. The system is inadequate to the requirements of the town both in extent and in character.

After discussing the requirements of the immediate future, and stating that the total demand from all sources for light, power and traction required immediately, is 5,100 KW., the question of power station site is discussed. It is said that considerable advantages will result from the adoption of a single generating station for the combined tramway, lighting and power requirements, notwithstanding that it will be necessary to keep the tramway and lighting cables distinct. The existing site of the gas and electric light works is recommended. It is fairly central; it has a siding from the railway for fuel, and there is a considerable amount of cheap water available. The area of this property is nearly 8 acres, which affords ample space for the gas works, for a large new electric generating station, and for a car-shed to accommodate as many of the tramcars as it may be desirable to house there.

The generating station would be so designed, that extensions could be made in a systematic way, at a minimum of cost. In the first place 8,100 KW. of plant would be required, but the engineers have provided in their estimates for a building capable of accommodating about 10,800 KW.

Three 1,350-KW. direct-current sets, driven by means of gas engines, are recommended for lighting and power supply in the inner area; three 675-KW. two-phase alternating sets, similarly driven, and one each 1,350-KW. and 675-KW. direct-current sets for tramways. The total capacity is thus 8,100 KW.

The reporters give various reasons for recommending the use of producer gas and gas engines, but their recommendation is subject to one reservation—that coal is found to be suitable. The tramway voltage will be 500 volts, and for the lighting of the inner area 460 volts across the outers of a three-wire system. The adoption of the direct-current system will permit of the existing street arc lamps being used without alteration. Underground cables would be used for the inner area, single-phase alternating-current generation with static transformers is to be employed for the outer area, which is mainly residential, but for certain parts adjacent to mining ground, which may change their character with the growth and development of Johannesburg, two-phase power supply is recommended, two-phase alternators being so constructed that the two phases can be used separately or combined. Single-phase cables would be laid to all transformer stations except these particular points, to which two feeder cables would be laid. Messrs. Mordey & Dawbarn say that in arranging the system in this way they combine the advantages of single-phase and multiphase working, and secure the simplest and cheapest arrangement of transformers, and the simplest, safest and cheapest system of high-pressure cables.

Low-pressure aerial cables will be employed for the outer area. In regard to street lighting, electric lamps will take the place of the 537 gas lamps. The number of arc lamps in the inner area will be increased from 62 to 171, and the area not served by arcs will have 32-C.P. glow lamps.

It is advised that in carrying out the reorganisation, the pressure of the system should be raised from 100 volts to 230 volts in the inner area, and from 120 volts to 200 in the outer area; £7,700 is included for the cost of replacing existing lamps and motors in this connection.

The tramways would be on a 4 ft. 8½ in. gauge, with 90 lbs. rails having a 1½ in. groove. The overhead trolley system is recommended, but the engineers have slight leanings towards the Dolter surface contact system. Though the cost of the latter is not very seriously in excess of the trolley, "in a place such as Johannesburg, where the cost of skilled labour is high, and where it would probably be considered an unnecessary expense to maintain the roadway between the rails at the degree of excellence which is desirable for this system." It is not recommended.

It is advised that if producer gas be used for generating the electric energy, it would be possible to serve the present gas mains with this gas for cooking-stove and gas-fire purposes.

INSTITUTION OF ELECTRICAL ENGINEERS.

Electric Wiring Up-to-Date.

The third meeting of the present session of the Glasgow Local Section of the Institution took place on January 14th, Mr. Henry A. Mavor in the chair.

Mr. W. A. Chamen, in opening a discussion on "Electric Wiring Up-to-Date," said that he had not prepared anything in the nature of a paper. The secretary had asked if he would start a discussion on the subject, and as this was a subject which attracted his attention at any rate as much as any other, he proposed to open the discussion by making a few remarks with regard to wiring up-to-date. "Up-to-date" did not mean quite what they would expect.

The first point that he particularly wished to speak about was the number of cases of trouble that they had with wiring consumers' installations connected to the Corporation supply. He did not suppose that any one firm of electrical contractors knew of the number of outbreaks of fire which were really caused in one way or other by bad electric wiring. One of the most fruitful causes of trouble seemed to be the improper use of metal-sheathed tubing with slip joints. Time after time when there had been a fire and he had investigated the matter, the causes of the trouble were found to be the careless use of this tubing and its fittings, threaded on to the wires like beads on a string. Often the proper bends, elbows, connectors, or other special fittings designed by the makers for use with this tube were absent altogether, and gaps were left between the ends of adjoining tubes or between junction boxes and tubes, or sometimes these fittings were threaded on to the wire but not put together, being left hanging, with their sharp edges and with the sharp edges of the tubes, ready to cut through the insulation of the wire. There was, of course, no pretence at continuity, or bonding and earthing these isolated bits of tube or fittings. The proper wooden ferrules for protecting the wires from the sharp edges at the ends of tubes, at switch or light points, were very frequently not put in at all, and sometimes were found threaded on to the wires but not attached to the end of the tube, so that they were rendered quite useless. At some point or other in the installation the wire would get its insulation damaged by one of these edges, and the tube would become alive. This was bad enough, but, unfortunately, it was only the beginning of the trouble. Where these fires had occurred it was usually found that at some point or other one of these lengths of tube which had become alive was in contact with a tin or compo gas pipe, and that an electric arc had been set up by the current finding its way to "earth" through the gas pipe. This arc burned a hole in the gas pipe, and also ignited the gas coming from the hole. There could scarcely be a more effective or certain way of starting a fire, but it was made still more effective by the fact that the gas pipe melted away through the heat of its own flame. This flame, therefore, after setting fire to any woodwork at its starting point, proceeded to travel, sometimes quite a long distance, for instance, between the joists under floors, setting fire to every successive point it passed. The real damage was, of course, caused by the gas becoming ignited.

How was this shamefully careless work to be avoided? Would not the chances of it be greatly reduced if the use of tubes with slip joints were absolutely prohibited, and where iron, steel or other strong metal tubes were used, it was only under the condition that they should be either solid drawn or welded and jointed together only by properly screwed joints, just like iron gas barrel? Would not this necessitate the employment of only properly skilled men who could not, without being guilty of the most wilful carelessness, leave their work in such an unfinished state? It surely would not be possible to employ such unskilled and inexperienced persons for screwed joints as were evidently thought good enough by some contractors for a slip joint job. He sympathised most heartily with those contractors who were anxious to do good work, but who, by quoting a proper price for such work, suffered in open competition with the less scrupulous or less competent contractors. The latter, by putting in inferior material and by doing the work in a slovenly and careless manner, possibly by means of labourers or untrained apprentices, could well afford to quote a much lower price. He asked that the electrical contractors of Glasgow would help him to find some means of stopping this kind of thing, for if something were not done soon to put an end to it, they would have the fire offices on their track demanding higher premiums for electrically-lighted buildings.

Regarding the difficulty of gas pipes and electric tubes becoming mixed up, of course we might blame the electric people for carelessness where they did not avoid this in carrying out their work. In several cases, however, they had not been guilty of the mixing up at all. The gas people had come along after them and put in gas pipes, running them against the electric tubes. It seemed to him that, looking a little ahead into the present century, it was not unlikely that contractors for gas fitting and for electric lighting would be the same parties, and that the same men would lay both the gas pipes and the electric wires, as well as bell wires, for these also occasionally got into the mischief in some way. Possibly the plumbers' work also would go to the same contractors. At any rate, it seemed to him that there were at present too many different contractors at work in domestic residences, and that troubles and risks would probably be reduced by such a combination. Another point he ought to mention, which was a terribly sad confession for engineers, was that the number of cases of fire with wood-casing installations of the old-fashioned kind was very small indeed. The fact still remained, however, that wood casing was dangerous if not properly dealt with, and in fact where there was any chance of its coming in contact with continuous moisture or dampness of any kind it should not be used at all. It was to be noted that what were called electric fires were for the most part really gas fires, though, unfortunately, started by electricity. The risk such as it was, really arose from gas, and not from electricity. Even where the electric wiring was not all that it should be, anything in the nature of a fire that might arise as a result of bad wiring on an electric installation, apart from complications with gas would almost invariably be discovered before any serious damage could be done. What he asked the meeting to do was to express their own

views about the whole question. If they could suggest anything that could be done either among themselves, or that he could do by rules to lessen the risk of fire and increase the efficiency of electric wiring, he should be very pleased indeed, and would think that the evening had not altogther been wasted.

Mr. H. B. MAXWELL said that the accidents to which Mr. Chamen had referred were almost entirely due to bad work, which almost always took place in the case of metal sheathing. In most cases the metal sheathing was not properly connected to earth. Another point he had noticed in Glasgow was that the architects were apt to insist on a certain class of work. He had also had trouble with wood casing, and he would emphasise what Mr. Chamen had said about its not being used in damp places, such as, for instance, a fishmonger's shop.

Mr. HUTCHESON said that his firm had been in a quandary as to what was the best system of wiring to use, and had adopted screwed tubing. They had concluded years ago that the old split tubing, with slip joints, was unsatisfactory. They had also tried twin-lead wiring, and he thought that, for old buildings, it was more suitable than anything else, though there were difficulties inseparable from it. Perhaps, after all, wood casing had more virtues than any other method. When the Kelvinside Co.'s station was taken over by the Corporation, it was only those installations that were wired with wood casing that had never required overhauling in the majority of cases.

Mr. UNDERHILL said he would like to know if some steps could not be taken to ensure that compo. gas piping would not be used by gas fitters. It should not, he thought, be a very difficult matter for iron piping to be substituted for compo. He thought that most contractors would be very glad if Mr. Chamen would refuse to pass anything but screwed tubing where tubing was used at all.

Mr. J. MARTIN CARR said that he quite agreed with Mr. Underhill.

Mr. W. MCWHIRTER said that the thing to do was to bring pressure to bear on the trade, so that nothing less than screwed tubing would be accepted. Wherever electric light is in a house, no such thing as compo. gas tubing should be used. With regard to the workman question, it was most difficult to deal with. The Electrical Contractors' Associations were endeavouring to introduce a system of registration by which there would be no difficulty in tracing a man who had been guilty of such misdemeanours in the way of slovenly workmanship as had been described.

Mr. COATS said he had used Simplex tubing with perfect satisfaction, and he always took care to ensure metallic continuity by bonding with copper, as well as by having knees, T-pieces, and couplings screwed, the tubing itself being, of course, also screwed.

Mr. E. GEORGE TIDD said that there had been a lot of talk about rendering bad systems safe by altering methods of running the gas pipes. It seemed to him that the chief concern of electrical engineers was to see that their own system was so safe that whether it touched the gas pipes or not there should be no risk of gas cum electrical fires. So long as there was a continuous metallic sheathing from the lampholder down to the Corporation fuses, and this was thoroughly earthed, this happy result would be attained. The whole of the trouble with fires, such as Mr. Chamen had described, was entirely due to inefficient earthing, and this was in a number of cases due to inherent faults in the system employed. Could not Mr. Chamen insert a rule in his regulations for supply stating the maximum resistance which he would allow between any point of metallic sheathing and earthing? When the insulation was tested, the metallic sheathing at remote points from the source of supply could be very easily tested to earth, and if the result was not satisfactory it might well be assumed that the system was faulty. He would also like to ask why Mr. Chamen considered it safer to insist that lampholders must be insulated. He considered himself that the lampholder, as much as any other part of the system, should be earthed, as a lampholder was the likeliest part of the system to come in contact with and under favourable conditions, such as recently occurred at Fulham, would be as liable to cause the same results as the metal tubing did in that case.

Mr. H. A. MAVOR, the chairman, thought that engineers were now in general agreement that there ought to be a continuous earthed metallic envelope over the conductors, and that the most satisfactory method of achieving this was to use a concentric system with the outer conductor connected to earth. The present methods of using metallic conduits appeared not only dangerous, but unnecessary. Both conductors in the conduit were equally insulated, whereas one of them only stood at a very little above the earth potential. Great difficulties must be encountered to make a permanently satisfactory earth connection to the metallic conduit, and the easiest method of meeting the condition requiring an earth connection was also the best, viz., to use a concentric conductor with the outer connected to earth. By this method the risk of discontinuity in the earth conductor was reduced to a minimum. There was absolute safety from fire and shock, and the earthing could be made consistent down to the last point. The reason why wood casing had proved the most satisfactory method of those hitherto generally adopted was a very simple one; it was because wood-casing was fitted by joiners, and the joiner was by far the most reliable class of tradesman for inside work. He had never looked with anything but alarm at the introduction of metallic tubing. This method of doing the work, he considered, was dangerous for many reasons. That the insurance companies should hold out a prospect of increasing the premiums on buildings wired on this method was no empty threat. The increase in the use of electric motors for which large conductors were used with a consequent increase of risk from bad workmanship, made it more than ever necessary that the insurance companies should be more vigilant with regard to the method of wiring in the class of work which they allowed to pass. It was to the interest of the whole industry that whatever method of wiring was used, every precaution should be taken to see that the workmanship was first-class; that no such work as Mr. Chamen had been describing should be allowed to exist, and that contractors should be still more careful to see that they employed men of such a character that there was some tangible guarantee of efficiency and capability for the work on which they were to be employed.

In reply, Mr. CHAMEN said he thought that he could go away feeling that they would endorse his action if in a re-issue of rules for wiring he insisted upon having only solid metal tube systems where tube systems were adopted, with screwed joints throughout. With regard to Mr. Maxwell's remarks about earthing, his experience was that the earth connection in installations was a most uncertain thing. That was the reason why it seemed to him to be necessary to keep clear of girders and all metal work. Mr. Underhill had suggested that it might be possible to stop the use of compo gas tubing. He (Mr. Chamen) some time ago had issued a circular to the architects of Glasgow pointing out the dangers that arose from the use of compo tubing when it happened to be in close proximity to electric conductors, and asking them to use their influence with a view to having iron gas barrel substituted for compo or tin tube in any gas fitting work that might come under their control. He had no doubt that most of the architects put his circular in the waste-paper basket, but one or two of them did take notice of it. With regard to Mr. Tidd's remarks about the earthing of lampholders, he was of opinion that if they earthed lampholders they would have more trouble than if they did not. The present make of lampholder was not suitable for earthing, and it was simply from experience that he had insisted upon having the lampholder insulated. With reference to Mr. Tidd's other remarks regarding the resistance to earth from the furthest-away lamp, this was all very well in theory, but he was afraid that a great many of the contractors of the present day would not understand what it meant. Mr. Mavor had spoken of earthing the neutral conductor, but he (Mr. Mavor) knew that they had not yet succeeded in carrying the Board of Trade far enough to get their permission for this to be done. In conclusion, he wished to thank them for the way in which they had received his remarks and for their comments upon them.

EARLY APPLICATION OF MAGNETO-ELECTRIC MACHINES FOR ELECTRO-METALLURGICAL PURPOSES.*

THE application of dynamic electricity, produced by steam power, to the purposes of electro-metallurgy, and, in particular, to the deposition of metals, appears to have been introduced into the industry at a date much earlier than that often assigned to it by writers on the subject.

After Faraday had shown that induced electric currents could be generated by the mechanical movement of coils of wire between the poles of either a permanent magnet or an electro-magnet excited by a voltaic battery, various inventors produced special forms of machines. Faraday himself described several forms of magneto-electric machine, and Pixii, of Paris, constructed others, of which the first generated alternating currents; while a later form had a commutator to reverse the currents, and render them suitable for chemical purposes. Subsequently other forms of greater power were produced by Saxton, Sturgeon, and Nollett. Woolrich, of Birmingham, seems to have made a remarkable advance in the useful application of such machines. In the "Manual of Electro-metallurgy" of the late Mr. G. Shaw (published by E. C. Osborne, of Birmingham, in 1844), there occur the following records:—

(p. 15). "Mr. Woolrich has succeeded in applying the magneto-electric current to the reduction of metals, a discovery which promises to be of greater importance than any with which the art has hitherto been enriched."

(p. 57). "Mr. Sturgeon appears to be the first who deposited metals by this apparatus, but his experiments were on a small scale, and it is to Mr. J. S. Woolrich, of Birmingham, that the art is indebted for the perfection of the magneto-electric apparatus, and the development of its extraordinary power as an electro-metallurgical instrument"

"Mr. Woolrich constructs machines after two models; one resembles, to a considerable extent, that of Mr. Saxton, and is used where a moderate amount of work is to be performed, and the other is a modification of one of the early magneto machines; this latter form is employed where large quantities of electric power are required."

After describing both these forms, and giving pictures of them, Mr. Shaw states that the small machine, making 1,000 revolutions per minute, deposits 120 ounces of silver per week, and that the larger machine, making 650 revolutions per minute, deposits from 300 to 400 ounces of silver per week. He then contrasts the great expense inevitable, in the use of voltaic batteries for depositing zinc, and the commercial gain in depositing by means of the machine, in which the expense "is limited to the power required to produce the rotation of the armature," and in paying for the wear and tear of the axis in its bearings, and of the contact springs. He then concludes (p. 64):—"The uniformity of the current developed in the magneto-electric machine is not the least of the many advantages this machine possesses. In the best constant battery the

* *Journal of the Society of Arts*, January 30th, 1903.

quantity varies during the course of several hours, and even the best operators, with the battery, find it necessary to give close attention to the state of the instrument and the progress of the deposition. With the magnetic machine the deposition goes on with extreme regularity; and, when once adjusted, may be left for any length of time without fear of derangement. So accurately is the deposition by this machine proportioned to the time of working, that, in an establishment in Birmingham where this process is extensively employed, the quantity of metal deposited is estimated by the time during which the machine works; repeated weighings having demonstrated that the relation between the time of working and the quantity of deposited metal is sufficiently accurate.

Watt's "Electro-Deposition" also mentions Woodrich's machine, the date of which is 1842. The original large machine is now the property of the Birmingham City, the industry of which it helped to build up.

A still more interesting step in the development of electric machinery is mentioned in Napier's "Manual of Electro-Metallurgy" (R. Griffin & Co.), 1857, where, on page 46, we find the statement that "this means of obtaining the electricity for the purposes of electro-metallurgy has recently been much improved by forms of magnets, &c., patented by Mr. Millward, and described by him as follows:—'The first branch of the improvements is carried into effect by the employment of an electro-magnet, formed by a current of electricity produced from a magneto-electric machine, instead of that generated in a voltaic battery.'" The use in machines of an electro-magnet excited by a battery had, it is true, been foreshadowed by Faraday; and Wheatstone had, in 1845, patented the substitution of a "voltaic magnet" for a permanent magnet. But Millward's invention carries the development one stage further. For while the electro-magnet in Wheatstone's (and Faraday's) machine was separately excited by the currents from a battery, the thing described by Napier is a separately excited electro-magnet, separately excited by means of the currents from a magneto-electric machine having permanent magnets.

One cannot read these early treatises of Napier and Shaw without being struck with their clear recognition of the fact that the real agent in the generation of these currents was dynamical power. Mr. Shaw, who died a few years ago, was a well-known chemist and patent agent.

Woolrich's machine was an object of much interest in the Birmingham Electrical Exhibition, a dozen years ago.

RECONSTRUCTION OF THE N.T.C. AT GLASGOW.

The Glasgow telephone area extends to 143 square miles. In that area the National Telephone Co. has opened 24 exchanges, having over 12,000 subscribers actually connected therewith, besides a large number waiting to be joined up. These extend to places so far in the west as Clydebank, in the east to Baillieston, in the north to Milngavie, Kirkintilloch and Kilsyth, and in the south to Giffnock, Clarkston and Busby. There is practically no part of the telephone area which is not served by the National Telephone Co.'s system.

In order to effect an improvement in the service, it was decided some time ago to absolutely reorganise the whole system, substituting metallic circuits, or twin wires in place of the old single wires. It was further decided that in the city the open wires should be discarded, and overhead cables of the newest type erected. This was done with a view to obviating the disturbances which were inevitable with an open-wire system. It was arranged with the leading railway companies to lay cables throughout their extensive underground tunnels in Glasgow, in addition to which the company now obtains a large number of junction wires in pipes under the streets connecting exchange with exchange, from the Post Office, and this has, in a large measure, met the difficulty with which the company was confronted at one time by the refusal of the Glasgow Corporation to allow underground cables in Glasgow.

A number of new exchanges have been opened, so as to obviate the congestion of subscribers in the large exchanges. All the important switch rooms in the area have been reconstructed with a view to bringing into use the latest type of switching apparatus, similar to that which has been adopted in large American cities, and in a number of the most important exchanges which have recently been equipped in this country. It is generally agreed that this is by far the best and most up-to-date system known.

As the subscribers in Glasgow are aware, the method adopted during the last ten years has been the call-wire system, but the company decided to discard that system, not only because of its inherent objections, but because it was recognised that a newer and better system was available.

The two principal switch rooms in the area are Argyle and Royal, and a description of one of these will give a representative idea of the whole.

The company acquired two of the top floors of the large block of buildings in Argyle Street belonging to Messrs. Jas. Goldie and Son, and altered them to suit its requirements. The top floor has been set out entirely as a large switch room, motor, and battery room, and also for the operators' dining and retiring rooms.

The exchange is capable of accommodating 8,800 subscribers, and is equipped at the present time for 2,000 lines. On the roof of the building, a large square derrick has been erected, and a most interesting feature is the method adopted of taking in the cables which converge from all sides to this central point. Elaborate supports have been fitted up, capable of taking in the cables required. These overhead cables are similar to those laid underground, with the exception that instead of a lead covering, a thick vulcanised rubber tube is used as an outside protection. It is only within very recent years that this class of cable has been made practicable for aerial purposes, and it is much lighter in weight than any of the telephone cables which were previously in use, the insulating material being dried paper.

The cables are taken down two large shoots to what is termed the test room. They are carried in the first case to what is technically known as the "arrester and heat coil frame." This apparatus is inserted at this point, so that, in the event of lightning, or stray currents from the overhead trolley circuits, getting on to the telephone wires at any point, the apparatus in the exchange would be protected, although the fact of the wires being now in cables practically does away with this possibility. It may be mentioned that at the subscriber's premises apparatus for a similar purpose is fitted up to protect the instrument there.

From the arrester frame the cross-connecting wires are carried to test jacks. These are a succession of brass springs to which the subscribers' lines are taken in numerical order, for the purpose of testing either the outside line or the inside apparatus connected with each individual subscriber. From the test jacks the wires are carried to a large intermediate distributing board. By means of this distributing board the exchange manager is enabled to alter the operating position on the switchboard of any busy subscriber, and thus equalise the work at each operator's position.

The wires branch off from the intermediate distributing board to the switch room upstairs, and to a set of relays. These little instruments answer a very important part in the working of the exchange. When a subscriber wishes to call the attention of the operator, he depresses a key momentarily; a current flows along the line and attracts a small armature on the relay, thus making an electric contact which lights a small electric lamp in front of the operator immediately below the subscriber's telephone number. The operator thereupon lifts a small brass peg and inserts it in the "jack," or line spring. This has the effect of putting her telephone in connection with the subscriber's line, and automatically extinguishes the calling lamp. The subscriber then gives the number he desires, and the communication is immediately effected by the operator inserting a second peg into the "jack" of the number asked for. After the conversation is completed, the subscriber again depresses his key momentarily, and this lights the clearing lamp, thereby indicating to the operator that the call is finished.

In the construction of this exchange about 540 miles of covered wire were laid inside the premises, and about 310,000 soldered wire joints were required.

In the switch room the operations are conducted with quietness, only the very slightest hum being heard. Tiny incandescent lamps flash in and out, and thousands of calls are effected from hour to hour without confusion or delay. The energy for working the exchange is obtained from a set of secondary batteries placed immediately alongside the test room. There are two large motor-generators at work, which, with the power board fitted up in the same room, give the appearance of a small electric station. The building throughout is lit by electricity, and a very effective design is used over the switchboards for throwing the light only on that part of the board where numbers require to be seen, the calling lamps before referred to being in the shadow.

In the laying-out of the entire system in Glasgow, over 12,000 miles of wire have been erected in overhead cables. Over 7,000 miles of wire have been laid in underground cables in the various railway tunnels, and under the streets in a number of the outside burghs adjoining the Glasgow municipal area, where the company was able to make arrangements with the burgh authorities; and in addition to this, the cables laid down by the Post Office under the various streets within the municipal area amount to over 1,400 miles of wire. In order to effect this huge reconstruction, hundreds of men have been at work, the company being able, with its vast resources, to draw on its various large centres for extra assistance.

REVIEWS.

The Rating of Electric Lighting, Electric Tramway and Similar Undertakings. By W. G. Bond. London: The *Electrician* Printing and Publishing Co., Ltd. 2s. 6d. net.

Mr. W. G. Bond has published a useful treatise on the above subject, intended to describe the principles and practice involved in what he rightly calls "our *so-called* system of rating." He deals more particularly with electric tramway undertakings, and publishes a mass of useful data showing the *modus operandi* of levying the rates, and of appealing against the decisions of assessment committees.

The methods adopted by the authorities in arriving at the rateable value (which he illustrates by a specimen value

of an electric tramway), he explains with great clearness, proving how the amount of the assessment is arrived at, and an application of the principle of averages of the accounts of two or three years.

At the end of the book Mr. Bond publishes in tabular form the actual results of the assessments of electric tramway and lighting undertakings, selected from typical towns and districts in London and the provinces, to prove how the system works.

Mr. Bond has contributed a timely digest of the existing system of valuation of industrial undertakings involving the use of public roads, and he is entitled to great credit for the clear and concise way in which he has accomplished his task.

After reading Mr. Bond's "booklet," as he modestly calls it, one is surprised at the utterly unsound principle adopted in valuing such properties for contribution to the rates.

If the valuation were being made with a view to the charge for income and property tax, we could understand the elaborate calculations resorted to for getting at a valuation on the basis of gross receipts, less expenses, the result being the rateable value. How if the expenses exceed the receipts (a not uncommon result in electrical undertakings, especially in their initial periods)?—no rates should be paid at all; or, as Mr. Bond naively puts it, "Obviously the assessment of an undertaking, the rateable value of which is returned at *more* than its *bonâ fide* net receipts, requires looking into."

The ordinary method of assessing buildings should not be departed from in the case of electrical or gas undertakings, but some special system must, no doubt, be followed in dealing with the use of the public highways, and in arriving at a rental value in respect of such user. In this case the ground landlord should contribute his share, but this opens up very wide and important considerations with which we cannot deal.

The whole question of rating of great industrial undertakings, *including those carried on by municipalities* whose accounts by no means prove that any uniformity exists in the methods of charge, requires to be dealt with by the legislature.

Manual of Electrical Undertakings and Directory of Officials. By Emil Garcke. Vol. vii. (1903). London: Manual of Electrical Undertakings, Ltd., 14, Norfolk Street, W.C. 15s.

Each issue of this well-known publication which everybody electrical speaks of as "Garcke's Manual," becomes more bulky and more valuable than its predecessor. It is undoubtedly head and shoulders above its fellows as a statistical guide to the finance and general position of British electrical manufacturing, also electric lighting, power and traction, both municipal and company. We note that the progress of the industry during 1902 was not so great—if the rate of progress may be judged by the increase of capital issued—as in the previous year. At the date of making up the *Manual* figures, the amount stood at £186,158,964, representing an increase of only about 20 millions, as against about 40 millions in the year before. There are many useful maps of power scheme areas, inter-urban electric tramway schemes, authorised and suggested tube railway schemes. There is once more presented the coloured diagram showing in graphic form the comparative results of the working of all electricity supply undertakings, and among the new features of the 1903 edition is the addition of a similar diagram showing in colours the working results of electric traction systems. For the man who is interested in the commercial side of electricity—in however remote a degree—Garcke's Manual is the most serviceable book of the year.

Hazell's Annual for 1903. London: Hazell, Watson and Viney, Ltd.

This well-known annual hardly needs commendation, for its 18 issues have built up for it a wide connection of readers in all ranks of society. The sub-title terms it "A Cyclopædic Record of Men and Topics of the Day," and it is certainly valuable as a reference work. A very wide field is covered—in fact, to put it in brief, there is something on everything. There is a short account of "electricity in 1902," in the course of which it is remarked that "a well-timed and valuable summary of the electrical power industry was issued by the Electrical Review, September 12th."

Motoring Annual and Motorists' Year-Book, 1903. London: *Motoring*. Illustrated. 3s. 6d. net.

This is the first edition of a work which will be of interest to all who are connected with the manufacture of motor-cars and the larger crowd of users. There are about 60 pages of photographs of well-known motorists of both sexes, fair and unfair. A directory of the objects and members of the Automobile Club and other similar associations are given, and a variety of notes relating to general motor-car matters, such as regulations, speeds, how to overhaul and repair, &c.

Directory of Electric Lighting and Electric Traction. By C. S. Vesey Brown. 1903. London: Hazell, Watson and Viney, Ltd. 6s. net.

This is the third edition of a book whose low price brings it within the reach of even the assistant engineer who wants to get an idea of what's what in the electricity undertakings of other towns. It contains a great mass of statistical data respecting all electric lighting and tramway works in operation in Great Britain and Ireland, and also tells something of the projected undertakings. Its main sections are electric lighting works, electric traction works, light railway undertakings, tube and other railways. Wherever obtainable, the editor has included the chief figures from the last financial returns of the different stations. Separate from, and in addition to, the general statistical notes, there is given at the end of the book a general alphabetical index of officials at all works. There are several other publications covering pretty much the same ground, but the low price and the excellence of its general get-up, also its strong binding, are not the least among the good points of Mr. Vesey Brown's work.

OVERHEAD WIRES AND MUNICIPAL TRADERS.

[BY OUR LEGAL CONTRIBUTOR.]

In our issue of last week we published a short note of the result of an appeal to the Court of Appeal in the case of the Finchley Electric Light Co., Ltd., *v.* The Finchley Urban District Council. The decision, however, is worthy of more than a passing notice, inasmuch as it closely affects the interests of all those who generate and supply electricity to consumers without the sanction or assistance of any provisional order or special Act.

Although we have frequently adverted to this case in these columns (it has been before the Courts in one form or another since the Autumn of 1901), it may be worth while to recapitulate the facts, in order to give our readers an opportunity of realising the real significance of the decision. It may be well to explain, at the outset, that the true importance of the case lies in its bearing upon municipal trading, and the methods which are sometimes adopted by those who advocate this form of enterprise.

It is now a matter of common knowledge that, subject to certain minor restrictions, electricity can be supplied to consumers without a provisional order. The facts in the case under notice were shortly as follows:—

The Finchley Electric Lighting Co. were incorporated in 1900 with the object (*inter alia*) of supplying current for electric light at Finchley. They held no license, provisional order, or other statutory power, but were duly served with a copy of the Board of Trade regulations, with which they complied. The defendant Council were the holders of a provisional order for the supply of electric light in their district, but had not exercised their powers. As a result of certain legal proceedings, the plaintiffs undertook not to open up any streets in Finchley for the purpose of laying mains without the consent of the defendants. An application for leave to

open up a certain road having been refused, the plaintiffs stretched overhead mains across certain highways in the defendants' district. The mains were supported by poles erected on private lands on either side of the highway. On October 1st, 1901, the defendants' surveyor gave directions for the wire to be cut. This order was carried out upon the following day, and the plaintiffs immediately applied to the Lord Chief Justice, who was then sitting as vacation judge, to restrain the commission from further acts of a similar kind. When the case came on for hearing in the ordinary course in the Chancery Division the injunction was dissolved.

Mr. Justice Farwell decided that inasmuch as the site of a road had been originally conveyed to turnpike trustees in fee simple for the purpose of making a road under the Turnpike Roads Acts, and as the road had afterwards become a highway, the whole estate which was vested in the trustees, *i.e.*, the fee simple, became vested under the Public Health Act in the District Council as urban authority, and that they were entitled to prevent electric wires being carried over the road at any height whatever. This decision was based upon the rule of law that the owner of the fee simple of any property is entitled to the use of the space above his property *usque ad cælum*. It follows that the suspension of wires across a freeholder's land amounts to a trespass in law, although it may not be shown that any rights of freeholder are actually interfered with. After argument in the Court of Appeal, their Lordships decided last week that Mr. Justice Farwell had arrived at a wrong conclusion, and they granted a perpetual injunction "to restrain the defendants from severing or otherwise interfering with the electric lines or cables of the plaintiffs over Regent's Park Road or any other road or street within the urban district of Finchley, over which the defendants had no greater rights than were vested in them by virtue of Sec. 149 of the Public Health Act, 1875, or from doing any act whereby the plaintiffs might be hindered or obstructed in carrying lines over or across any of such roads or streets at a height not less than that required by the regulations of the Board of Trade."

The above decision must be taken with the limitation that upon the facts as proved the Court of Appeal were satisfied that the fee simple of the road was not vested in the Urban District Council as highway authority; had they come to a different conclusion upon this point, they would probably have refused to grant the injunction. It is in the highest degree important, however, to note that this title to the fee simple of the road must be made out by any local authority which desires to follow the example of the Finchley Urban District Council. With a provisional order in their office, in spite, possibly, of frequent requests on the part of the inhabitants that electricity might be supplied for public and private lighting, this Council not only refused to put their order into operation, but adopted the violent methods described in the case under review in order to stifle the energies of a private company. It is in the highest degree satisfactory to find that this move in the campaign of municipal *versus* private enterprise has been rudely checked in the Court of Appeal.

It will be observed that the Finchley case was decided in respect of a district outside the County of London; but it was decided some years ago that the Metropolis Management Act, 1855, does not confer upon a vestry or board of works (constituted under that statute) such a property in the streets situate within their district as to entitle them to maintain an action for an injunction against the erection of a telephone across a street, the telephone wire being at a great height and causing no appreciable danger to the public or to the traffic in the street. (Board of Works for Wandsworth *v.* the United Telephone Co., 13 Q.B.D., 904.) The question of overhead wires within the administrative County of London is regulated by the London Overhead Wires Act, 1891, which enables the County Council to make bye-laws with regard to (*a*) the identification of the wires by registration or otherwise; (*b*) the regulation of wires; (*c*) the strength of the materials to be employed in placing, maintaining, and supporting the wires; and (*d*) the removal of wires erected or placed otherwise than in accordance with such bye-laws, and of disused wires. These bye-laws are administered by the local authorities.

It may be said with some show of reason that the local authorities ought to be allowed to have control over the placing of electric lines anywhere in the metropolis; but we fail to see why they should ever be permitted to have such an interest in rural highways as to prevent the suspension of suitable cables with the consent of the landowners on either side.

The Finchley case is a direct authority for the proposition that the title to the fee simple must be clearly made out before the local authority have any right to interfere.

It is unfortunate for the cause of municipal trading that its supporters should find it necessary to have recourse to the actions which gave rise to an application for an injunction in the first instance.

We have alluded to the fact that the District Council were in the possession of a provisional order which they had not put into force. This fact, coupled with certain other recent manifestations, appeared to evince a reluctance on the part of the local authorities to embark upon costly electrical enterprise, although egged on thereto by the exponents of municipal trading. We observe, for instance, that the proposal contained in the London County Council (General Powers) Bill, 1903, to the effect that local authorities should be allowed to deal in electrical fittings does not command universal support, even on the part of the very borough councils for whose benefit the County Council are promoting this part of the Bill. Thus at a meeting of the Westminster City Council on February 12th, the question whether the Law and Parliamentary Committee of the Council ought to support the Bill was discussed. Dr. Des Voeux moved that a petition should be entered against the Bill. He observed that whatever views the Committee might have about the London Borough Councils discharging duties in connection with the supply of electric light, they ought to oppose any metropolitan boroughs setting up as electric fitters. "If this is allowed," he said, "we shall have proposals for the sale of meat by the Councils." The chairman of the Committee opposed the motion on the ground that "it was possible that, in a few years, the City Council would be supplying electric light and power, and they did not desire to do anything which might hamper their successors." We are glad to observe that the amendment in favour of petitioning against the Bill was carried. It is pleasing to find that, amongst a host of local authorities in London, who, following the example of the London County Council, rush blindly into the meshes of municipal trading, there can be found at least one influential body who are averse to taking further steps in this direction.

THE I.E.E. MODEL GENERAL CONDITIONS FOR CONTRACTS.

It is an old saying that everything comes to those who can wait. This, we take it, will be the feeling of many an electrical engineer receiving under date of 1903 the form of Model General Conditions recommended by the Institution of Electrical Engineers for use in connection with contracts for plant, mains and apparatus for electricity works.

It is ten months since the draft of the present issue was submitted for the criticism of the members of the Institution, over two years since the Committee was appointed by the Council to prepare it, and five years since the need for some standardisation of general practice was felt to be so urgent that a Joint Committee of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association prepared some standard clauses in the hope that their adoption would improve what was even then felt to be a deplorable state of affairs.

However, "Better late than never," and though the pressure of enlightened public and professional opinion has done much to confine within reasonable limits the vagaries of the inexperienced but ambitious consultant, as well as the socialistic aspirations of the popularity-loving town councillor there yet remains a wide field in which the influence of the proposals before us may do much good.

It will be remembered that the Committee was appointed largely on the initiative of Mr. Robert Hammond, M.I.C.E., and in his speech to the members of the Institution on behalf of the Committee last April, he confessed to having had a large share in the compilation of the draft conditions then submitted.

These proposals gave rise to so much discussion that it was necessary to summon a special meeting for their further consideration. The earnestness of many of the speakers showed the importance of the subject, and must have led many of the members of Council to ask themselves whether it would not have been well if they had several years earlier endeavoured to remove some of the real grievances shown to be affecting the stability and prosperity of the industry.

We dealt at the time with the many criticisms directed at the phrasing of the various clauses, and it is interesting to note how far the Committee have profited by the advice given by those taking part in the discussion.

The clauses are still, in our opinion, far too verbose. The 49 in the original draft are now reduced to 48, but the phrasing has been altered as little as possible. This seems a mistake, for had clearness and terseness been aimed at, the conditions would have been much more likely to become popular.

The alteration in the number of clauses is due to the omission of those relating to the Local Government Board's sanction and the interview with engineer, and the insertion in a new clause of a stipulation that payments shall be made by the purchaser within 30 days of the issue of the engineer's certificate. Dealing with the clauses *seriatim*, we find that the present issue differs from the original draft in the following particulars:—

Clause 3 now reads that "unless otherwise specified" the foundations and builders' work will be provided by the purchaser.

In Clause 4 "each" contractor for plant in the engine house is to have at his own risk the free use of the overhead travelling crane.

A stipulation is added to Clause 6 guarding the purchaser from being bound by specifications of apparatus sent in by a contractor with his tender unless these specifications are definitely approved by him and incorporated in the contract.

This seems to us to be fair, and it is as well to have it definitely stated, for in the past uncertainty as to its application has been the cause of many misunderstandings.

The addition of two words to Clause 7 makes it clear that tenderers are entitled to have samples as well as drawings returned in cases where their offers are unsuccessful.

In Clause 8 the purchasers now bind themselves not to call upon a tenderer to accept a contract for a portion only of any of the sections of the specification, a stipulation implied, but not expressly stated in the draft.

Clause 10 has been varied to meet the criticisms which were directed against it. It now places the onus as well as the expense of preparing the contract and bond upon the purchaser, and demands that they be forwarded to the contractor for signature within 30 days of the acceptance of the tender. If there is a delay of more than 30 days on the part of either party in executing the contract, it is to be open to the other party to determine the contract if he so desire.

In the clause dealing with contract drawings, a new paragraph demands the approval or otherwise of drawings submitted to the engineer within 14 days of their receipt by him. It was elicited during the discussion that in several cases heavy losses had been incurred by contractors solely on account of the delay caused by the difficulty of obtaining any decision from the engineer with regard to drawings submitted for his approval. It is expressly stated that drawings of constructional details further than those which in the opinion of the engineer are required for the purpose of the contract, are *not* to be demanded from the contractor.

In the original draft the clause relating to approved apparatus was very unsatisfactory. There was no protection for the contractor against unreasonable demands made by the engineer. In the new rendering this defect is remedied; and provided the contractor has either submitted drawings or sent in a full description of any apparatus included in his tender, he is not to be called upon without extra payment to substitute for it a higher-priced article.

A paragraph is added to Clause 17, stipulating that, should a change of address occur on the part of either party and be notified in writing to the other, all notices under the contract shall be sent to the new address.

An important modification is made in the clause relating to patent rights. It now protects the contractor against any claim which may be made in respect of any system or method of use that may be specifically mentioned in the specification. This is a valuable safeguard, for hitherto many contractors have had to run serious risks as regards patent suits, simply because a purchaser would insist on them infringing some well-known patent, while not admitting any personal responsibility in the matter. As now worded, the clause is fair to all parties, protecting the purchaser on the one hand, and guarding the just rights of the contractor on the other.

The next clause, dealing with quality of materials, has been slightly altered to meet the wishes of several critics, and now demands materials of the best quality unless otherwise specified.

In the paragraph referring to the powers of the engineer to vary work, the new price, if not arranged by the schedule, shall be decided by the engineer and contractor *jointly*, not by the engineer alone, and the time in which the contractor must furnish details of extra work done under the contract is reduced from two months to 30 days.

It is now also stipulated that if extras are required or modifications demanded, the cost of patterns prepared, or partly prepared, for work as originally specified, shall be considered and allowed for when determining the cost of the extra.

Paragraph 21 deals with negligence, and whereas originally the purchaser was not liable for *loss or wear and tear* of any part of the contractor's plant, if used by him as a result of the contractor's negligence, it is now stipulated that any damage above *fair wear and tear* shall be paid for by the purchaser to the contractor.

A curious addition is made to Clause 22, dealing with death or bankruptcy of the contractor. Should the executors or representatives of the contractor so desire they are to have the option, subject to the sanction of the engineer, which shall not be unreasonably withheld, to complete the work after *so increasing the amount of surety as to be equal in value to the uncompleted part of the contract.*

In the original draft the phrasing of the clause relating to appeals to arbitration needed amendment. Read in conjunction with the arbitration clause itself it was satisfactory, but in itself it was ambiguous. Despite, however, the fears expressed by some consultants in the course of the discussion that even as worded it might hurt the feelings, *not of consultants or engineers, but of purchasers*, the wording has been altered to read that *all decisions of the engineer shall be subject to the right of arbitration reserved by these conditions.*

With a slight alteration made in the arbitration clause it will thus be seen that the new draft fully concedes the right of the contractor to appeal from any decision of the engineer, if he so desire, to an absolutely independent authority.

It is wisely stipulated that work under the contract shall proceed during any arbitration proceedings.

Part of Clause 31 has been revised and now relieves the contractor of responsibility during the period of maintenance of any acts not caused by the acts or omissions of himself or his servants. In the past this has been a fruitful cause of disputes, and it is well to have the responsibility definitely allocated.

The terms of payment remain as in the draft:—

Eighty per cent. of value of work delivered or executed on the site to the satisfaction of the engineer.

Ten per cent. one month after completion or at option of contractor one month after being put into beneficial use.

Ten per cent. nine months later.

Since it is further stipulated that all moneys are to be paid within 30 days of the issue of the certificate, it will be seen that the clause provides for the actual payment of all claims within 12 months of completion. The maintenance clause is also worded so that responsibility on the part of the contractor ceases with the issue by the engineer of the last certificate.

The stipulations as to due dates of completion are unaltered except that all reference to the Local Government Board is deleted. This clause still appears unnecessarily long, and might with advantage be recast.

The Institution adheres to the principle of graduated penalties for late completion which Mr. Hammond has used in his own work for so long. It is interesting to note that in this approved form, the amount of penalty is only to be calculated on the value of that part of the plant which by reason of late completion cannot be put into beneficial use. The maximum percentage penalty is one per cent. of this value, and it is not till after a period of three months that this figure is reached.

The description of the routine to be followed at the tests on completion, covers a full page of the model form; we know men who would safeguard all interests and specify their wants in a dozen lines or less.

The purchaser's right of use of plant before final completion of the contractor's work is limited under Clause 42. If through the default of the contractor the specified tests on completion have not been made, such use by the purchaser shall be at the contractor's risk. It is further stipulated that if by reason of an appeal to arbitration, payments to contractor are delayed, interest calculated at the rate of 5 per cent. per annum is to be paid in respect of any such payments representing plant or apparatus placed in beneficial use.

The clause referring to rejection of inefficient work remains practically the same. The option is still retained by the purchaser either to allow the contractor to remedy the defect, or to replace the defective work at the expense of the contractor, or to entirely reject it, and recover any sums paid on account from the contractor.

A final paragraph stipulates that the contract shall in every case be regarded as in accordance with English law, and that all payments made in regard to it shall be in sterling money.

It will be seen that this model form is the result of a real attempt to apply just principles to the conditions governing commercial transactions, and the Institution is to be congratulated on the completion of a confessedly difficult task. We fear, however, that its belated appearance and inordinate length will prevent its ever exerting that potent influence for good upon the industry which an authoritative model form, made up of concisely-worded clauses embodying similar principles, would have won for itself if issued six or seven years ago.

THE ANNUAL DINNER OF THE G.E. CO.

Last Saturday evening the thirteenth annual dinner of the General Electric Co., Ltd., was held at the Trocadero Restaurant. Over 300 ladies and gentlemen sat down, many of whom were guests of the directors and staff of the company, and amongst these were Mr. James Swinburne, Mr. Gavey, Major-General W. Webber, Col. Crompton, Mr. Dane Sinclair, Mr. M. F. Roberts, Mr. Philip Dawson, Mr. Parshall, Mr. Medhurst, Mr. Probert, and many others well known in the electrical profession and trades.

The chair was taken by Mr. Hugo Hirst, who gave the loyal toast in a few well-chosen words, and afterwards asked the company to drink to the health of the Imperial forces, coupling with the toast the names of Major-General Webber and Col. Crompton. In replying, General Webber spoke most earnestly of the value of engineering training, and Col Crompton made a very amusing speech, in which he naturally referred to the Electrical Engineering Volunteers

Mr. Hirst then rose to toast the staff of the G.E. Co. After referring to the fact that many members of the staff whom the directors had nursed from the position of office boys in the early days were now holding responsible positions, and in many cases were personal friends of the directors, he spoke of the terrible fire of last year, and said he was sure that the thoughts of all present were those of sympathy with the relatives of the deceased. The staff had helped the firm to the prominence that they now held, but although they had worked hard in the past and done their duty, he hoped they would do more than their duty in the future. Last century Great Britain was left practically free to extend her Empire and her commerce, whilst other countries were chiefly fighting amongst themselves; as a result we had accumulated enormous riches and obtained the premier position, but other countries eventually stopped fighting and secured a period of rest, during which they worked up their position as commercial nations, and rapidly came to the fore. Some people said that it was due to that fact, others that Free Trade was the cause, and others, again, that municipal trading or want of education was at the bottom of it; but one thing was certain, that the rate of progress in this country was not what it should be; other countries had undoubtedly done everything they could to attack the commerce of Great Britain, and it behoved us to fight hard to maintain it. In a concern like the G.E. Co., he said that the only answer was "Fight." They had built huge works, had laid down the best and most modern machinery, and had obtained good men; but in order to succeed, they must be backed up by the staff, who, he repeated, should improve their minds, work hard, and rise to a higher level by doing more than their duty. He coupled with this toast the name of Mr. F. G. Bell and Mr. T. H. Bacon.

Mr. Bell returned thanks on behalf of the staff for the kind words of advice from the directors, and concluded by proposing the health of the directors.

Mr. Bacon began by stating that the staff recognised the services of its directors. The directors were often to be seen going about the place with glum faces; there was only one remedy for this, and customers had it in their hands. He concluded by referring to the approaching visit to South Africa of Mr. Bevis, who, he thought, would have accompanied Mr. Chamberlain, had not Mr. Chamberlain been afraid that South Africa could not hold two such great men at the same time. He wished Mr. Bevis, on behalf of the staff, "God speed." Mr. A. Eckstein briefly returned thanks on behalf of the directors, and also acknowledged the health of the staff; Mr. Bevis also thanked them all for their wishes for his journey.

Mr. Max Byng read a letter from the chairman of the company, Mr. G. Byng, to the staff, and toasted the guests of the evening, coupling with the toast the names of Mr. James Swinburne, President of the Institution of Electrical Engineers, and Mr. Gavey, Engineer-in-Chief of the Post Office.

Mr. James Swinburne, who was received with acclamation, said he admired the enterprise of the G.E. Co, and he unreservedly withdrew the remarks in his Presidential address regarding the word "limits" as applied to the G.E. Co. This concern could not have risen to its present position without cordiality between the departments; this was a great feature in the success of a large business. He was sure the G.E. Co. made everything. The business was wonderful, and their catalogue was more wonderful still. It did not matter what he wanted, he had only to look in that catalogue, and he would find it. For example, if he wanted an electrical brush, he looked in the catalogue and found it priced at £149 15s. 9d. On expressing surprise at the high price, he was told, "Oh, but there is a discount off this; the net price is 4½d; the list price only represents the value of the goods."

Mr. Gavey spoke of the enormous increase in the electrical industries in the last three or four years, and briefly returned thanks for the honour that had been done him.

Mr. Medhurst proposed "The Health of the Chairman," and bore testimony to the fact that the General Electric Co. could fight, and fight honestly, and after that be firm friends. The toast was received with acclamation and musical honours.

Mr. Hirst briefly responded, and proposed "The Health of the Ladies." Then Mr. Dane Sinclair added a few words regarding Mr. G. Byng, the chairman of the company, who was at the moment abroad.

After this the company adjourned for a short interval, and later on a most enjoyable evening was spent watching the marvels of Dr. Byrd-Page, and listening to the eccentricities of Messrs. Barclay Gammon and John Warren.

During the evening an excellent programme of music was provided by Lieut. Dan Godfrey's string band.

ELECTRICAL NEWS FROM SOUTH AFRICA.

[From our Special Correspondent.]

Somerset Strand, Cape Colony.—An application for a concession to build and run an electric tramway from Somerset Strand Station to the town is now being considered by the municipality.

Woodstock, Cape Town.—£1,200 is to be spent on street lighting during 1903 by the Council in this suburb.

Bloemfontein.—The amount authorised to be spent in electric lighting has been increased to £25,000. A contract for the further extensions has been concluded.

Pretoria.—Messrs. Mordey & Dawbarn, who are consulting engineers to both the Johannesburg and Pretoria Municipalities, have been instructed to draw up a full report upon the electric lighting and tramways of Pretoria, with estimates as specified, the fee being fixed at 500 guineas.

Lourenço Marques.—Mr. Horne Shaw, of Henderson's Consolidated, was here last month in connection with the electric tramways, work on which is to be started this month.

Volksrust, Transvaal.—The Government last month considered a scheme for the electric lighting of the town and station. Most likely the railway authorities will put down the plant and supply the town in bulk. This is urgently needed, as shunting operations are carried on all night.

Lourenço Marques.—A new telephone company, with a capital of £20,000, has been organised, which will absorb the old company and its plant. A service will be instituted with Johannesburg, giving direct communication between the two centres.

Potchefstroom, Transvaal.—The Director of Public Works is considering a scheme for the electric lighting of the town.

Stellenbosch, Cape Colony.—The Town Council is considering a scheme for the electric lighting of the town.

Simons Town, Cape Colony.—At a meeting of the Public Works Committee, a representative of the Pioneer Gas and Electric Light Co. was present, and laid his views before the meeting with regard to the lighting of the town. He considered a scheme of gas lighting to be preferable to one of electric lighting, although the initial cost would be greater. He based his reasons for this on the assumption that gas would be more convenient for street lighting and domestic purposes. The Council instructed him to draw up a report on both systems, with estimates, for it to consider.

Krugersdorp, Transvaal.—The Health Board has a scheme for the electric lighting of the town. An offer from the Lancaster G.M. Co. to supply current at 7d. per unit, delivery to be taken on the mine property, has been refused, the Board having decided to instal a plant of their own at an estimated cost of £8,000 with motors, and £5,500 without.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

2,423. "Improvements in electric lampholders." T. Chalmers. February 2nd.

2,425. "Improvements in high-tension electrical wires used for ignition purposes." C. H. Guest. February 2nd.

2,429. "Improvements in and relating to the make-and-break mechanism of induction coils." A. Watson, Jun. February 2nd.

2,471. "Improvements in and relating to secondary electric batteries." Q. Marino and E. Cleary. February 2nd.

2,481. "Improved method of effecting electric traction and appliances for the purpose." G Bamberg. February 2nd.

2,489. "Improvements in and connected with electric lifts." J. Richmond and R. F. Carey. February 2nd.

2,491. "Improvements in electro-magnetic motors." A. Pol Y Aguirre. February 2nd. (Complete.)

2,502. "Improvements in the regulation of arc lamps." Siemens Bros. and Co. (Siemens & Halske.) February 2nd. (Complete.)

2,508. "Improvements in apparatus for controlling and stopping vehicles, engines, and other bodies driven by electricity or other motive power." W. L. Wise. (G. A. Webb, Natal.) February 2nd.

2,512. "Improvements in and relating to electric lights." G. W. Lavbourn. February 3rd.

2,513. "Safety system of earthing electric light and other conductors." A. J. Beaumont. February 3rd.

2,544. "A combination, fireproof, draw-in system of electric light wiring and tubing." J. A. Wilkie. February 3rd.

2,547. "Improvements in quick-break electrical switches." F. A. La Roche. February 3rd. (Complete.)

2,564. "Improvements relating to the brake apparatus of electric railway and tramway vehicles." The Johnson-Lundell Electric Traction Co., Ltd. (J. G. V. Lang.) February 3rd. (Complete.)

2,574. "An improved electrolytic process for the direct extraction of metals from ores and the like, and for the precipitation of the metals from the solutions, and apparatus therefor." Mechwart, Coltri & Cie. February 3rd. (Complete.)

2,575. "Improvements in and connected with electric incandescent lamps." J. O. Rhodes. February 3rd.

2,598. "Improvements in and relating to electrical transmission systems." E. E. Clement. February 3rd. (Complete.)

2,604. "Improvements in or relating to induction coils." C. Ropiquet. February 3rd.

2,669. "Improvements in or connected with electric arc lamps." F. M. Lewis. February 3rd.

2,622. "Improvements in and relating to electric devices for automatically actuating the shuttle shifting or stopping mechanism in looms for weaving when the cops are emptied." D. M. Hollins. February 3rd.

2,638. "Improvements relating to track and conductor switch points of electric tramway systems." J. H. Maire. February 4th.

2,644. "Improvements in switch operating devices for conduit systems of electric tramways and railways, applicable also for operating signals of various descriptions, or for analogous purposes." J. D. Edwards. February 4th. (Complete.)

2,696. "Improvements in and relating to incandescent electric lamps and switches." G. Sweetser. February 4th.

2,700. "Improvements in electric circuit breakers." J. D. F. Andrews. February 4th.

2,746. "Improvements in electric service main and other switches for breaking and closing electric circuits." J. R. Craig, Jun. February 5th.

2,770. "Improvements in connection with the trolley poles of electric tramcars of locomotives." G. A. Baker. February 5th.

2,774. "Improvements in or connected with ratchet-operated electric switches." W. Kingsland. February 5th.

2,800. "Improvements in electric call bells." Y. M. Harscoet-Braquezec. February 5th.

2,805. "Improvements in magnetic clutches." C. Jenatzy. February 5th. (Complete.)

2,822. "Improvements in dynamos and motors." T. W. S. Hutchins. February 6th.

2,849. "A dynamo-electric speed regulator, adaptable also as a brake." W. A. Dutton. February 6th.

2,853. "Improvements in electric switch lampholders." T. H. Jones and T. L. Jones. February 6th.

2,857. "Improvements in or relating to cars for trolley wires of electric tramways." C. Close and J. Ramsey. February 6th.

2,865. "Improvements in or relating to electric arc lamps." C. Oliver. February 6th.

2,903. "Improvements appertaining to switches and points of electric tramways and railways." J. B. Crompton. February 7th.

2,907. "Improvements in electric ignition for motor-cars." C. M. Linley and G. H. Smith. February 7th.

2,928. "Improvements in electric tramway systems." R. Zuppinger. February 7th. (Complete.)

2,930. "Couplings for conduits for electric conductors." D. S. Munro. February 7th.

2,940. "Improvements in and relating to lighting by electric or other energy." M. Barr and E. Le Riche. February 7th.

2,961. "Improvements in electrically-actuated semaphores." Siemens Bros. and Co., Ltd., and L. M. G. Ferreira. February 7th. (Complete.)

2,963. "Improvements in and relating to telegraph and telephone cables and the like." G. F. Mansbridge. February 7th.

2,976. "Improvements in or relating to electric switches." E. Knipping. February 7th.

2,980. "Improved means for effecting the speed regulation of continuous current electric motors." E. S. W. Moore and T. L. Boyden. February 7th. (Complete.)

2,985. "Improvements relating to the supporting and fixing of electric wires." J. R. P. Lunn. February 7th.

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

16,658. "Improvements in the manufacture of filaments for incandescent electric lamps, and in apparatus for use in such manufacture." W. L. Voelker. (Patent not yet due for sealing.) Dated August 19th, 1901.

16,670. "Improvements in electrical indicators." J. W. Manley. Dated August 19th, 1901.

16,677. "Improvements relating to the manufacture of electrodes for galvanic batteries." R. Pörscke. Dated August 20th, 1901.

16,710. "Improvements in electrical switches." H. W. Cox. Dated August 20th, 1901.

16,762. "Improvements in and connected with electric switches." H. O. Farrell. Dated August 21st, 1901.

16,810. "A new or improved relay and methods of employing the same in connection with multiplex telegraphy, telephone systems and the like." P. O. Pedersen. Dated August 21st, 1901.

16,814. "Improved means for use with overhead electric conductors for the prevention of danger in the case of telephone, telegraph or other wires falling across them." R. P. Wilson. Dated August 21st, 1901.

16,874. "Improvements in electrolytic apparatus for production of chlorine and alkali." J. Mactear. Dated August 22nd, 1901.

16,911. "An improved plug and socket detachable switch for electrical connectors." F. W. Heaton and H. Smith. Dated August 23rd, 1901.

16,941. "Improvements in and relating to electric arc lamps." L. B. Codd. Dated August 23rd, 1901.

16,955. "Improvements in and relating to electrical inter-communication." A. van Wagenen. Dated August 23rd, 1901.

16,979. "An improved electric switch." J. Mitchell. Dated August 24th, 1901.

17,023. "Improvements in alternating electric current transformers." H. M. Hobart. Dated August 24th, 1901.

17,024. "Improvements in insulating material for electrical apparatus." British Thomson-Houston Co. (W. C. Fish.) Dated August 24th, 1901.

17,025. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (A. D. Lunt.) Dated August 24th, 1901.

17,026. "Improvements in electric circuit-breakers." British Thomson-Houston Co. (E. M. Howlett.) Dated August 24th, 1901.

17,027. "Improvements in locks for electric motor controller handles." British Thomson-Houston Co. (J. B. Linn.) Dated August 24th, 1901.

17,028. "Improvements in electric brakes for electric railway vehicles." British Thomson-Houston Co. (C. E. Barry.) Dated August 24th, 1901.

17,029. "Improvements in lightning arresters." British Thomson-Houston Co. (H. R. Sargent.) Dated August 24th, 1901.

17,030. "Improvements in electric insulating material and the application of the same in the construction of commutators for dynamo-electric machines." British Thomson-Houston Co. (W. le R. Emmet.) Dated August 24th, 1901.

17,039. "Improvements in or relating to rifle-range telephones." C. R. Crosse. Dated August 24th, 1901.

17,070. "Improvements in or connected with incandescent electric lamps." A. L. Reinmenn. Dated August 26th, 1901.

17,088. "Improvements in dynamo-electric machines." M. W. W. Mackie and E. J. Glyn. Dated August 26th, 1901.

17,132. "Improvements in the construction of insulators for electrically separating sections of overhead trolley lines and the like." R. C. Quin. Dated August 27th, 1901.

17,144. "Improvements in supporting devices for brush holders for dynamo-electric machines." A. O'N. Fox. Dated August 27th, 1901.

17,187. "Improvements in cells for primary batteries." A. Lessing. Dated August 27th, 1901.

17,193. "Improvements in electric switches or circuit breakers." British Thomson-Houston Co. (E. M. Howlett.) Dated August 27th, 1901.

17,194. "Improvements in electric arc light electrodes." British Thomson-Houston Co. (R. H. Read.) Dated August 27th, 1901.

17,215. "Improvements in the construction of insulators for supporting overhead trolley lines and the like." R. C. Quin and J. F. Simpson. Dated August 28th, 1901.

17,249. "Improvements in magneto-electric machines." F. R. Simms and R. Bosch. Dated August 28th, 1901.

17,256. "An improvement in the connecting of electrically-propelled cars." Siemens Bros. & Co. and A. Siemens. Dated August 28th, 1901.

17,320. "Improvements in or relating to the electrolytic manufacture of chlorates perchlorates, bromates, iodates and the like." P. E. C. Corbin. Dated August 29th, 1901.

17,349. "Improvements in or relating to the electric locomotives operated by accumulator batteries." O. Bohm and R. Menckhoff. Dated August 29th, 1901.

17,337. "Improvements in or relating to trolley arms for electrical conductors." S. A. Hunter. Dated August 29th, 1901.

17,363. "Aluminous press-button for electric bells for indicating when the attendant is coming." C. Dauvey. Dated August 29th, 1901.

17,381. "Improvements in the electric lighting of railway carriages." E. O. Mawson. Dated August 30th, 1901.

17,383. "Improved safety devices for guard wires of trolley wires and other conductors." D. S. Monroe. Dated August 30th, 1901.

17,425. "Improvements in circuit-breaking apparatus for electrical circuits." British Westinghouse Electric and Manufacturing Co. (L. B. Stillwell.) Dated August 30th, 1901.

17,480. "An improvement in electrolytic polarisation cells having an aluminium electrode." Siemens Bros. & Co. (Siemens & Halske, Aktiengesellschaft.) Dated August 31st, 1901.

17,489. "Improvements in armature windings for dynamo-electric machines." H. M. Hobart. Dated August 31st, 1901.

17,561. "Improvements in electro-magnetic spark extinguishing or arc preventing devices for electric switches." H. A. Bertram. Dated September 2nd, 1901.

17,567. "Improved combination of electric motors for starting and operating them." J. Burke. Dated September 2nd, 1901.

17,601. "Improvements in apparatus and devices for controlling current." S. Watkins. (Consolidated Railway Electric Lighting and Equipment Co.) Dated September 3rd, 1901.